



AGRICULTURAL RESEARCH INSTITUTE
PUSA

TRANSACTIONS AND PROCEEDINGS
OF THE
BOTANICAL SOCIETY OF EDINBURGH.

TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH

VOLUME XXVI.

INCLUDING SESSIONS LXXVI.-LXXIX

(1911-1915)

WITH NUMEROUS ILLUSTRATIONS



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PROCEEDINGS
OF THE
BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXVI.

NOVEMBER 9, 1911.

A. W. BORTHWICK, Esq., D.Sc., President, in the Chair.

The following gentlemen were elected Office-Bearers for the Session :—

PRESIDENT.

A. W. BORTHWICK, D.Sc.

VICE-PRESIDENTS.

W. B. BOYD, Esq.

Sir ARCHIBALD BUCHAN - HEP-
BURN, Bart.

J. RUTHERFORD HILL, Esq.

Professor J. W. H. TRAIL, M.A.,
M.D., F.R.S., F.L.S

COUNCILLORS.

T. BENNET CLARK, C.A.

ALEXANDER COWAN, Esq.

JAMES FRASER, Esq.

SYMINGTON GRIEVE, Esq.

R. STEWART MACDOUGALL, M.A.,
D.Sc.

GEORGE W. SCARTH, M.A.

W. G. SMITH, Ph.D.

W. W. SMITH, M.A.

Miss J. G. THOMPSON.

JAMES WHYTOCK, Esq.

Honorary Secretary—WILLIAM CRAIG, M.D., F.R.S.E., F.R.C.S.E.

Curator of Herbarium—W. CALDWELL CRAWFORD, M.A., F.R.S.E.

Foreign Secretary—Rev. D. PAUL, M.A., LL.D.

Treasurer—RICHARD BROWN, C.A.

Assistant-Secretary—M'TAGGART COWAN, Junr., Esq.

Artist—Professor FRANCIS M. CAIRD, M.B, C.M., F.R.C.S.E.

Auditor—ROBERT C. MILLAR, C.A.

LOCAL SECRETARIES.

Aberdeen—Professor J. W. H. TRAIL, M.A., M.D., F.R.S., F.L.S.

Bathgate—ROBERT KIRK, M.D, F.R.C.S.E.

Berwick-on-Tweed—FRANCIS M. NORMAN, R.N.

Birmingham—W. H. WILKINSON, F.L.S., F.R.M.S., Manor Hill, Sutton Coldfield.

Calcutta—Professor S. C. MAHALANOBIS, B.Sc., F.R.S.E., F.R.M.S., Presidency College.

Cambridge—ARTHUR EVANS, M.A.

Croydon—A. BENNETT, A.L.S.

Dumfries—Professor G. F. SCOTT-ELLIOT, M.A., B.Sc., F.L.S.

Dundee—Professor P. GEDDES, F.R.S.E.

East Liss, Hants—JAMES SYKES GAMBLE, M.A., C.I.E., F.R.S.

Glasgow—Professor F. O. BOWER, Sc.D., F.R.S., F.L.S.

London—WILLIAM CARRUTHERS, F.R.S., F.L.S.

„ J. F. DUTHIE, B.A., F.L.S.

„ E. M. HOLMES, F.I.S., F.R.H.S.

„ Lieut.-Col. DAVID PRAIN, M.D., C.I.E., F.R.S., F.L.S., Royal Botanic Gardens, Kew.

Melrose—W. B. BOYD, of Faldonside.

Otago, New Zealand—Professor JAMES GOW BLACK, D.Sc., University

Perth—Sir ROBERT PULLAR, F.R.S.E.

Philadelphia, U.S.A.—Professor JOHN M. MACFARLANE, D.Sc., F.R.S.E.

Ryde—GEORGE MAY LOWE, M.D., C.M.

St Andrews—Professor M'INTOSH, M.D., LL.D., F.R.S.E.

„ ROBERT A. ROBERTSON, M.A., B.Sc.

„ J. H. WILSON, D.Sc., F.R.S.E.

Toronto, Ontario—W. R. RIDDELL, B.Sc., B.A.

„ Professor RAMSAY WRIGHT, M.A., B.Sc.

The TREASURER, Mr. RICHARD BROWN, C.A., submitted the following Statement of Accounts for the Session 1910-1911:—

INCOME.

Annual Subscriptions for 1910-1911	.	.	.	.	£39	10	0
Do. Arrears.	.	.	.	.	4	10	0
Transfer from Life Members' Fund	.	.	.	.	7	11	2
Transactions sold	.	.	.	.	11	0	0
Subscriptions to Illustration Fund	.	.	.	.	6	3	0
Interest on Deposits in Bank	.	.	.	.	3	16	3
					<hr/>		
					£72	10	5

EXPENDITURE.

Printing (including Transactions for 1910-1911, £31, 2s. 9d.)	£42 11 5
Rooms for Meetings and Tea	6 10 0
Stationery, Postages, Carriages, etc.	2 15 9
Fire Insurance on Books, etc.	0 5 0
Honorarium to Acting Secretary	10 0 0
Excess of Income over Expenditure	10 8 3
	<hr/>
	£72 10 5

STATE OF FUNDS.

Life Members' Fund.

Balance of Fund at close of Session 1909-1910	£83 8 9
Deduct—Transferred to Income	7 11 2
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Balance as at close of Session	£75 17 7

Ordinary Fund.

Balance of Fund at close of Session 1909-1910	£67 2 4
Add—Increase during Session 1910-1911	10 8 3
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Balance as at close of Session	77 10 7
	<hr/>
Total Funds	£153 8 2
Being:—Sum in Current Account with Union Bank of Scotland Ltd.	£7 2 6
Sums in Deposit Receipt with do.	150 0 0
Due by Treasurer	6 5 8
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	£163 8 2
Less — Honorarium due to Acting Secretary	10 0 0
	<hr/>
As above	153 8 2

Note.—Subscriptions in arrear, 1909-10, £2, 5s. ; 1910-11, £8, 10s.

EDINBURGH, 30th October 1911.—I hereby certify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for Session 1910-1911, and have found them correct. I have also checked the foregoing Abstract, and find it correct
ROBT. C. MILLAR, C.A., Auditor.

Dr. BORTHWICK gave his presidential address, entitled
“Some Modern Aspects of Applied Botany” (see p. 1).

Mr. ARTHUR BENNETT communicated a paper on *Carex helvola*, Blytt (see p. 30).

Mr. JAMES M'ANDREW showed specimens of *Silene fimbriata*, Sims, from the south bank of the Crinan Canal, Argyll; and *Piptatherum multiflorum*, Beauv., from near Musselburgh (see p. 95).

Mr. JAMES FRASER showed *Centunculus minimus*, Linn., from Wigtownshire (see. p. 95).

DECEMBER 14, 1911.

A. W. BORTHWICK, Esq., D.Sc., President, in the Chair.

Miss AUGUSTA LAMONT and Mr. J. R. DRUMMOND were elected Resident Fellows.

Mr. JOHN DAVIDSON was elected a Non-Resident Fellow.

Mr. N. MILLER JOHNSON read a paper upon Ecological Terminology as applied to Marine Algæ (see p. 32).

Professor GIOVANNI ARCANGELI communicated a paper upon *Victoria regia*, Lindl. (see p. 56).

Mr. SYMINGTON GRIEVE read a paper upon *Argania Sideroxylon*, and illustrated it with lantern slides (see p. 88).

Mr. JAMES FRASER exhibited a number of alien plants, new British records, from near Edinburgh (see p. 28).

JANUARY 3, 1912.

A. W. BORTHWICK, Esq., D.Sc., President, in the Chair.

Mr. E. HOLMES SMITH was elected a Resident Fellow.

Professor F. O. BOWER read a paper showing the need for two new terms, "Pleioyeny" and "Meioyeny," as signifying the increase and decrease in the number of parts of plants, irrespective of the way in which that increase or decrease took place.

Mr. ALEX. MORRISON communicated a paper on New or imperfectly described Species of *Acacia* from Western Australia (see p. 51).

Dr. W. G. SMITH showed stereoscopic photographs, taken by Professor Massart, of Arctic-Alpine and other plants.

Dr. STIRTON sent for exhibition specimens of *Fissidens incurvus*, Starke, from Kyleakin, Skye.

Mr. RUTHERFORD HILL showed fresh rhizomes of Zedoary (*Curcuma aromatica*, Salisb.) from Tahiti.

FEBRUARY 8, 1912.

A. W. BORTHWICK, Esq., D.Sc., President, in the Chair.

Dr. D. H. SCOTT, Oakley, Hants, was elected an Hon. British Fellow.

Dr. MALCOLM WILSON and Mr. R. C. DAVIE were elected Resident Fellows.

Mr. M. Y. ORR communicated a paper on "Kenfig Burrows: an Ecological Study" (see p. 79).

Mr. W. BALFOUR GOURLAY read a note on a fastigiata Scotch Pine from Dryburgh, and showed specimens and photographs.

A specimen of *Leucobryum pumilum* (Michx.), sent by Dr. STIRTON, the discoverer of this moss in Scotland, was exhibited (see p. 44).

MARCH 14, 1912.

JAMES FRASER, Esq., in the Chair.

Dr. D. H. CAMPBELL communicated a paper on The Embryo-Sac of *Aglaonema*.

Dr. MALCOLM WILSON read a paper, illustrated by lantern slides, on the plant distribution of a special area in North Kent. Dr. Wilson gave an account of the various geological formations—chalk, alluvial, and gravel—and contrasted the floras corresponding to these geological formations both in deep shade and in the light. He also pointed out the zonation of the flora corresponding to the depth of soil overlying the chalk. This was specially the case with mosses.

Mr. W. W. SMITH exhibited abnormal leaves of *Sterculia alata*, Roxb., showing great variation on a single tree.

On behalf of Mr. H. F. TAGG there was exhibited a specimen of *Urtica dioica*, Linn., showing remarkable development of the stipules into leaf-like structures.

A series of new *Didymocarpi* from South-East Asia was exhibited by Mr. W. W. SMITH.

APRIL 11, 1912.

A. W. BORTHWICK, Esq., D.Sc., President, in the Chair.

Dr. W. G. SMITH read a paper entitled *Anthelia*: an Arctic-Alpine Plant Association (see p. 36).

Mr. ALEXANDER COWAN communicated a report upon the excursion of the Scottish Alpine Botanical Club (see p. 91).

Mr. JAMES FRASER showed specimens of *Vulpia setacea*, Parl., *Aegilops ventricosa*, Tausch, var. *truncata* Boiss. et Reut., *Lolium remotum*, Schrank, *L. rigidum*, Gaud., found by him as casuals or aliens in the neighbourhood of Edinburgh.

Mr. SYMINGTON GRIEVE showed specimens of *Pyrola secunda*, Linn., from Glen Garry.

MAY 9, 1912.

A. W. BORTHWICK, Esq., D.Sc., President, in the Chair.

Dr. K. GOEBEL communicated a paper on the Inflorescences of the Ambrosiaceæ (see p. 60).

Mr. E. M. HOLMES communicated descriptions of two new species—*Agathosma trichocarpa* and *Grateloupia subpectinata* (see pp. 76 and 78).

Mr. W. W. SMITH exhibited specimens and made some remarks upon the Himalayan *Daphnes*.

Dr. MALCOLM WILSON exhibited specimens of a new fungus-disease found on a *Pandanus* growing in the Royal Botanic Garden, Edinburgh.

JUNE 13, 1912.

A. W. BORTHWICK, Esq., D.Sc., President, in the Chair.

Dr. MALCOLM WILSON showed a new species of *Pyrenochaeta* (see p. 75).

Mr. W. W. SMITH exhibited ten new species of Burmese plants. These included a new *Lettsomia* and a *Homalium* from Maymyo; two *Polygonums* from Manipur; a *Vitex*, and a peculiar *Globba* from the Ruby Mines District of Burma.

PROCEEDINGS
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SESSION LXXVII.

NOVEMBER 14, 1912.

A. W. BORTHWICK, Esq., D.Sc., President, in the Chair.

The following gentlemen were elected Office-Bearers for the Session :—

PRESIDENT.

Sir ARCHIBALD BUCHAN-HEPBURN, Bart.

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W. G. SMITH, Ph.D.

Professor J. W. H. TRAIL, M.A.,
M.D., F.R.S., F.L.S.

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JAMES FRASER, Esq.
JAMES GRIEVE, Esq.

SYMINGTON GRIEVE, Esq.
J. RUTHERFORD HILL, Esq.
Miss J. G. THOMSON.
JAMES WHYTOCK, Esq.
MALCOLM WILSON, D.Sc., F.L.S.

Honorary Secretary—W. W. SMITH, M.A.

Curator of Herbarium—W. CALDWELL CRAWFORD, M.A., F.R.S.E.

Foreign Secretary—Rev. D. PAUL, M.A., LL.D.

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Artist—Professor FRANCIS M. CAIRD, M.B., C.M., F.R.C.S.E.

Auditor—ROBERT C. MILLAR, C.A.

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Bathgate—ROBERT KIRK, M.D., F.R.C.S.E.

Berwick-on-Tweed—FRANCIS M. NORMAN, R.N.

Birmingham—W. H. WILKINSON, F.L.S., F.R.M.S., Manor Hill, Sutton Coldfield.

Calcutta—Professor S. C. MAHALANOBIS, B.Sc., F.R.S.E., F.R.M.S., Presidency College.

Cambridge—ARTHUR EVANS, M.A.

Croydon—A. BENNETT, A.L.S.

Dundee—Professor P. GEDDES, F.R.S.E.

East Liss, Hants—JAMES SYKES GAMBLE, M.A., C.I.E., F.R.S.

Glasgow—Professor F. O. BOWER, Sc.D., F.R.S., F.L.S.

London—WILLIAM CARRUTHERS, F.R.S., F.L.S.

„ J. F. DUTHIE, B.A., F.L.S.

„ E. M. HOLMES, F.L.S., F.R.H.S.

„ Lieut.-Col. Sir DAVID PRAIN, M.D., C.I.E., F.R.S., F.L.S., Royal Botanic Gardens, Kew.

Melrose—W. B. BOYD, of Faldonside.

Otago, New Zealand—Professor JAMES GOW BLACK, D.Sc., University.

Philadelphia, U.S.A.—Professor JOHN M. MACFARLANE, D.Sc., F.R.S.E.

Ryde—GEORGE MAY LOWE, M.D., C.M.

St Andrews—Professor M'INTOSH, M.D., LL.D., F.R.S.E.

„ ROBERT A. ROBERTSON, M.A., B.Sc.

„ J. H. WILSON, D.Sc., F.R.S.E.

Toronto, Ontario—W. R. RIDDELL, B.Sc., B.A.

„ Professor RAMSAY WRIGHT, M.A., B.Sc.

Mr. E. HOLMES SMITH read a preliminary note on the Occurrence of Mucilage on the Roots of Melastomaceae, and exhibited photographs and specimens illustrating it.

Mr. R. C. DAVIE read a note on the Structure of the Leaf of some Species of *Banksia* (see p. 179).

Dr. MALCOLM WILSON gave a preliminary account of a disease in plums caused by a *Cladosporium*.

A paper on the Structure of the Embryo of *Laguncularia racemosa*, Gaertn., was read on behalf of Professor BAYLEY BALFOUR (see p. 186).

Mr. JAMES FRASER showed specimens of the following plants:—*Barbarea rupicola*, Moris, *Cnicus* (*Picnomon*)

Acarna, Linn., *Crucianella latifolia*, Linn., *Paronychia argentea*, Lam., *Corynephorus fasciculatus*, Boiss. et Reut., *Festuca Poa*, Kunth, *F. hemipoa*, Del., *F. dertonensis*, var. *Broteri*, Asch. et Grbn., *F. (Vulpia) setacea*, Parl., *Lolium subulatum*, Vis., *L. remotum*, Schrank, *Triticum ventricosum*, Ces. Pass. et Gib. var. *truncatum*, Hackel—casuals found by him in the county of Edinburgh; also *Barbarea praecox*, Br., *Guizotia abyssinica*, Cass., *Sedum album*, Linn., *Alopecurus utriculatus*, Pers., *Gaudinia fragilis*, Beauv.—casuals from Wigtownshire.

The following plants, new or uncommon in cultivation, were shown from the Royal Botanic Garden:—

Arenaria picta, Sibth. et Sm., from Asia Minor and Syria: a pink-flowered species resembling *Tunica Saxifraga*. *Cyananthus Forrestii*, Diels, a new species from Yunnan: a small-flowered species with pale lavender flowers and graceful habit. *Erodium Stephanianum*, Willd., Eastern China: a plant of the shores, with dark purple flowers. *Gentiana gentilis*, Franch., from Yunnan: an annual free-flowering Gentian with purple-blue flowers. *Lobelia taliensis*, Diels, a new species from Yunnan: small-growing, with purple-blue flowers. *Primula pseudo-capitata*, Ward: a new undescribed species from Yunnan, with rotate capitula, resembling *P. capitata*, but much smaller. *Psilostrophe Tagetinae*, Kuntze: a beautiful yellow-flowered composite from the Southern United States. *Saxifraga turfosa*, Engl. et Irmscher: a new yellow-flowered species from Yunnan, allied to *S. diversifolia* and *S. parnassifolia*, but distinguished by its long stolons. *Saxifraga* sp.: a new Yunnan species with yellow flowers, allied to *S. cinerascens*, Franch. *Selago spuria*, Linn.: a free-flowering, white-flowered species from South Africa. *Stylidium articulatum*, R. Br., Australia: one of the riband-leaved rosette forms of the genus. *Swertia angustifolia*, Ham.: a delightful pale lavender-flowered species with spotted petals from the Himalaya.

Mr. H. F. TAGG exhibited specimens of *Sclerotinia parasitica* (Masse), the tulip disease.

Mr. W. W. SMITH exhibited many new and interesting Compositae collected by Mr. George Forrest in Yunnan.

DECEMBER 12, 1912.

W. W. SMITH, M.A., in the Chair.

Mr. J. T. JOHNSTONE was elected a Resident Fellow.

The Assistant Secretary communicated a paper by Mr. GEORGE BROWN giving a Survey of the Vegetation of Shotts Parish, Lanarkshire (see p. 101).

A paper on the seedling of *Thysanotus* was read on behalf of Professor BAYLEY BALFOUR (see p. 185).

Professor J. B. BEWS gave a brief account of the botanical survey work being done in Natal, and indicated the various formations characteristic of that area.

Mr. JAMES WHYTOCK showed plants of *Begonia* injured by an insect of the genus *Tarsonemus*.

Dr. MALCOLM WILSON exhibited specimens of *Ophiobolus graminis*, Sacc., a disease on wheat.

Mr. H. F. TAGG showed examples of phyllody of flower parts in *Tragopogon pratense*, Linn.

Mr. W. W. SMITH showed two new Himalayan *Primulas* from the Chumbi Valley (see p. 118).

The following plants, many new to cultivation in this country, were shown from the Royal Botanic Garden:—

Haplopappus scaposus, Remy, a Chilean undershrub of the general feature of *Primula suffrutescens*, A. Gray: a good rockery evergreen. *Helichrysum Selago*, Benth. et Hook. f.: a New Zealand shrubby species showing markedly imbricate as well as spreading leaves. *Hydrocotyle hirsuta*, Sw.: a small-leaved form from San Domingo, with spikes of whorled sessile flowers. *Salvia controversa*, Tenore: a curious species from the Mediterranean region with bullate pinnatisect leaves and small blue flowers;

not very showy. *Trifolium tomentosum*, Linn.: a small-leaved form from the Mediterranean region with pretty trusses of red flowers.

A number of species of *Celmisia*, including: Small-tufted forms with short linear leaves—*C. laricifolia*, Hook. f.; *C. sessiliflora*, Hook. f. Longer linear-leaved forms—*C. Armstrongii*, Petrie; *C. Petriei*, Cheesem.; *C. pseudo-Lyallii*, Cockayne; *C. longifolia*, Cass.; *C. viscosa*, Hook. f. Broad-leaved forms—*C. holosericea*, Hook. f.; *C. Dullii*, Buch.; *C. hieraciifolia*, Hook. f.; *C. densiflora*, Hook. f.; *C. discolor*, Hook. f.; *C. incana*, Hook. f.; *C. Lindsayi*, Hook. f.; *C. Traversii*, Hook. f.; *C. petiolata*, Hook. f.; *C. spectabilis*, Hook. f.; *C. Brownii*, F. R. Chapm.; *C. verbasifolia*, Hook. f.; *C. coriacea*, Hook. f.

Young plants of the Bastard beeches of New Zealand: *Nothofagus Menziesii*, Oerst., *N. fusca*, Oerst.; and twigs of *N. cliffortioides*, Oerst. Also young plants of *N. obliqua*, Blume, from Chili.

JANUARY 9, 1913.

Sir ARCHIBALD BUCHAN-HEPBURN, Bart., in the Chair.

Miss BERTHA CHANDLER was erected a Resident Fellow.
Mr. M. H. TAGG was elected a Non-Resident Fellow.

The TREASURER, Mr. RICHARD BROWN, C.A., submitted the following Statement of Accounts for the Session 1911-1912:—

INCOME.

Annual Subscriptions for 1911-1912	.	.	.	£37	5	0
Do. Arrears	.	.	.	2	10	0
Transfer from Life Members' Fund	.	.	.	7	15	4
"Transactions" sold	.	.	.	2	10	0
Subscriptions to Illustration Fund	.	.	.	2	1	0
Interest on Deposits in Bank	.	.	.	3	13	0
Diploma	.	.	.	0	7	0
Excess of Expenditure over Income	.	.	.	8	6	8
				<hr/>		
				£64	8	0

EXPENDITURE.

Allowance to "Scottish Botanical Review" for Printing "Transactions"	£32 0 0
Printing Notices for Meetings, etc.	11 4 6
Rooms for Meetings and Tea	6 10 0
Stationery, Postages, Carriages, etc.	4 8 6
Fire Insurance on Books, etc.	0 5 0
Honorarium to Acting Secretary	10 0 0
	<hr/>
	£64 8 0

STATE OF FUNDS.

Life Members' Fund.

Balance of Fund at close of Session 1910-1911	£75 17 7
Add—Life compositions received	21 0 0
	<hr/>
	£96 17 7
Deduct—Transferred to Income	7 15 4
	<hr/>
Balance as at close of Session	£89 2 3

Ordinary Fund.

Balance of Fund at close of Session 1910-1911	£77 10 7
Deduct—Decrease during Session 1911-1912	8 6 8
	<hr/>
Balance as at close of Session	69 3 11
	<hr/>
Total Funds	£158 6 2
Being:—Sum in Current Account with Union Bank of Scotland Ltd.	£10 15 6
Sums in Deposit Receipt with do.	190 0 0
Due by Treasurer	10 15 2
	<hr/>
	£211 10 8
Less—Accounts unpaid at 31st October 1912	53 4 6
	<hr/>
As above	£158 6 2

Note.—Subscriptions in arrear, 1909-10, £2, 5s. ; 1910-11, £6 ; 1911-12, £8, 5s.

EDINBURGH, 27th December 1912.—I hereby certify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for Session 1911-1912, and have found them correct. I have also checked the foregoing Abstract, and find it correct.
ROBT. C. MILLAR, C.A., Auditor.

"A Contribution to the Flora of Arran," by WM. G. TRAVIS, was communicated by the Assistant-Secretary (see p. 120).

MR. N. MILLER JOHNSON read a paper, "The Invasion of Vegetation into Disforested Land" (see p. 129).

A paper on the Primulas of the Bullate section was read on behalf of Professor BAYLEY BALFOUR (see p. 188), and dried specimens of most of the members of the group were exhibited.

MR. M'TAGGART COWAN read a paper on *Cochlearia danica*, Linn. (see p. 136).

MR. W. W. SMITH exhibited a series of new Chinese plants collected by Mr. GEORGE FORREST, and also a new Burmese species of *Cordia*—*C. globifera*, W. W. Sm.—with very tomentose leaves.

The following interesting plants in flower were shown from the Royal Botanic Garden:—

Acanthocarpus Preissei, Lehm.: a remarkable South-West Australian plant of that group of Monocotyledones which seem to connect Juncaceae and Liliaceae; the twisted leaves are a prominent feature of adaptation to dry conditions. *Bulbine favosa*, Schult.: a strong-scented yellow-flowered South African plant. *Parthenium Hysterophorus*, Linn.: an American white-flowered species. *Pleione Delavayi*, Rolfe: a fine dark-flowered species of much better colour than any other in cultivation. *Pomaderris phyllaefolia*, Lodd.: an Australasian ericoid form. *Primula petiolaris*, Wall. var. *pulverulenta*, Hook. f.: a delightful plant introduced as *P. Winterti* from Kumaon, W. Himalaya. *Samolus ebracteatus*, H. B. K.: a Central American form with rather smaller flowers than our native species, *S. Valerandi*, Linn. *Saxifraga hederacea*, Linn.: white-flowered species of the *Cymbalaria* section from South-East Europe and Asia Minor, forming a nice cover on a rockery. *Sedum alamosanum*, S. Wats.; *S. cupressoides*, Hemsley; *S. longipes*, Rose—three Mexican species of *Sedum* of which *S. cupressoides* is of special

interest as a companion growth form to that of the South African *Crassula lycopodioides*, Lam.

FEBRUARY 13, 1913.

Sir ARCHIBALD BUCHAN-HEPBURN, Bart., in the Chair.

A paper was read on behalf of Professor BAYLEY BALFOUR on the Primulas of the Candelabra Section (to be published in part iii. of this volume).

A paper on the occurrence of *Utricularia ochroleuca*, Hartman, and *U. intermedia*, Hayne, in Scotland, was read on behalf of Mr. ARTHUR BENNETT (see p. 140).

Dr. MALCOLM WILSON showed specimens of potato tubers attacked by *Rhizoctonia violacea*, Tul. The fruiting stage of the fungus *Corticium vagum*, B. et C., var. *Solani*, Burt., occurs on the lower leaves, and in the specimens exhibited this stage existed in organic connection with the sterile mycelium on the tuber. The disease known as "little potato" is probably caused by this fungus.

Mr. ALEXANDER COWAN forwarded his report on the 1912 excursion of the Scottish Alpine Botanical Club to Killin and district (see p. 144).

Mr. JAMES M'ANDREW exhibited a new lichen, *Lecanora Andrewi*, B. de Lesdain, found by him near Edinburgh (see p. 184).

Mr. W. W. SMITH exhibited some new Saxifrages from the frontiers of Yunnan and Tibet collected by Mr. F. Kingdon Ward.

The following noteworthy plants in flower were shown from the Royal Botanic Garden:—

Clematis fasciculiflora, Franch.: an evergreen species, with greenish-white flowers. *Rubus parvus*, Buch.: a very distinct species from New Zealand, of creeping habit, with slender stems, and 1-foliolate leaves, which are of a bronzy yellow colour on the upper surface. The fruits are said to be large and juicy. It is a good rockery plant

likely to prove hardy. *Echeveria Pringlei*, Rose. *Senecio Burchelli*, DC.: a shrubby dense foliage-plant with bright yellow flowers from the Cape. *Omphalodes cornifolia*, Lehm.: a pretty blue-flowered plant from Asia Minor requiring a dry sunny position. *Romanzoffia Suksdorfii*, Greene: in appearance somewhat resembling a compact *Saxifraga* with dense green foliage, and flowers which are a very pure white.

MARCH 13, 1913.

Sir ARCHIBALD BUCHAN-HEPBURN, Bart., in the Chair.

The PRESIDENT intimated the death, since the previous meeting, of Dr. PAUL ASCHERSON, who had been a corresponding member of the Society since 1878; and of Dr. J. J. KIRK DUNCANSON, who had been a Resident Fellow since 1865.

A paper on the Primulas of the Sinensis Section: Part I., was read on behalf of Professor BAYLEY BALFOUR (to be published in part iii. of this volume).

Mr. GEORGE BRYCE read a paper on The Wild-Rubber Country of Madagascar, which was illustrated by lantern views of the restricted area where one of the species of *Landolphia* abounds. The vines, owing to the geological formation, are slender, and the yield scarcely repays the labour expended.

Mr. E. HOLMES SMITH read a paper on the Growth and Preparation of Flax Fibre in Belgium, illustrated with lantern slides.

Dr. R. S. MACDOUGALL showed specimens of the fruits of the red currant infected with the American Gooseberry Mildew, *Sphaerotheca mors-uvæ*, and pointed out that this is the first time this fruit has been recorded in this country as attacked by the fungus.

Mr. R. C. DAVIE gave an account of *Stratiotes Aloides*, Linn., the water soldier, in a small loch near Crieff, where it was planted in 1861 (see p. 180).

Mr. G. CLARIDGE DRUCE communicated Notes on Scottish Plants (see p. 147).

Professor J. ARCANGELI communicated a note on *Araucaria Bidwilli*, Hook. (see p. 151).

Mr. W. BALFOUR GOURLAY exhibited a specimen of *Viscum album*, Linn., growing on *Abies pectinata*, DC.

The following interesting plants in flower were shown from the Royal Botanic Garden:—

Androsace Delavayi, Franch., a species with pinkish or white flowers, smelling of hawthorn, from Yunnan. *Cheiranthus asper*, Cham. et Schlecht. (= *Erysimum capitatum*, Greene): a half-hardy species with creamy white flowers; not often seen in cultivation nowadays. *Pittosporum rigidum*, Hook., f.: a hardy New Zealand species. *Ariopsis peltata*, Nimmo, Himalaya. *Osmanthus Delavayi*, Baill., Yunnan. *Ribes laurifolia*, Jancz.: an evergreen with numerous racemes of greenish flowers; one of Wilson's Chinese plants. *Ribes viburnifolia*, A. Gray: a compact bushy plant from California; flowers reddish brown.

APRIL 10, 1913.

T. BENNET CLARK, Esq., C.A., in the Chair.

Mr. JAMES BREBNER and Mr. R. E. COOPER were elected Non-Resident Fellows.

Professor BAYLEY BALFOUR read a paper on the Primulas of the Sinensis Section: Part II. (to be published in part iii. of this volume), and exhibited many living plants, dried specimens, and photographs.

Mr. JAMES FRASER showed specimens of the following plants recently gathered by him:—*Fumaria purpurea*, Pugsley, *F. Bastardi*, Bor. var. *hibernica*, Pugsley, *Sisymbrium officinale*, Scop. var. *leiocarpum*, DC., *Petasites fragrans*, Presl, *Symphytum peregrinum*, Ledeb., and *Mentha rubra*, Sm.—from Wigtownshire; *Fumaria officinalis*, Linn., var. *Wirtgeni*, Haussk., *Anarrhinum bellidi-*

folium, Desf., *Festuca rigida*, Kunth, var. *patens*, Asch. et Grbn.—from Midlothian.

Mr. JAMES M'ANDREW showed specimens of *Coronilla varia*, Linn., and *Bromus inermis*, Leyss., which he recently gathered—the former at Slateford, Midlothian; the latter in the same place and at Leven, Fifeshire.

Mr. W. W. SMITH showed *Pleurospermum amabile*, a new species from the Chumbi Valley, Tibet (see p. 154).

Dr. MALCOLM WILSON showed *Ustilago Vaillantii*, Tul., on *Chionodoxa Luciliae*, Boiss., obtained in the Royal Botanic Garden, Edinburgh.

The following interesting plants in flower were shown from the Royal Botanic Garden:—

Alyssum pyrenaicum, Lap.; *Cardamine rhomboidea*, DC.; *Crenularia eunomoides*, Boiss.; *Cytisus Beanii*, ×; *Gaultheria Forrestii*, Diels, one of the finest flowering shrubs introduced for Bees, Ltd., by Mr. FORREST from Yunnan, the racemes of white flowers being 8–10 inches long; *Saxifraga Eastwoodiae* (Small),¹ an American saxifrage of the Boraphila section; *Ranunculus Monroii*, Hook., f., var. *dentatus*, a New Zealand plant with large yellow flowers; *Roscoea cauleoides*, Gagnep., var. *lutea*, a delightful acquisition from Yunnan, the result of Mr. Forrest's collecting (there is also a purple-flowered form in cultivation); *Saxifraga lilacina*, Duthie, a Kabschia saxifrage from Kumaon introduced by Kew in 1900, not yet common in gardens (recent explorations in China show that the section Kabschia occurs also there in *S. pulchra*, Engler, also now in cultivation); *Suksdorfia violacea*, A. Gray, a purple-flowered saxifragaceous plant which gives promise of being useful on the rockery; *Thlaspi Kovatsii*, Heuff.; *Thlaspi rivale*, Presl.

MAY 8, 1913.

Sir ARCHIBALD BUCHAN-HEPBURN, Bart., in the Chair.

The HON. SECRETARY communicated a paper by Mr. ALEX. P. STEVENSON on "William Gardiner, Author of the Flora of Forfarshire (1848)" (see p. 155).

¹ Under *Heterisia* in "Nor. Amer. Fl.," xxii. 156.

Mr. H. F. TAGG read a paper on the occurrence of *Agaricus melleus*, Vahl, on Gooseberry bushes in fruit plantations in Kent.

Professor BAYLEY BALFOUR exhibited a large and interesting series of photographs of Chinese Primulas, cultivated at the Royal Botanic Garden, and also a series of photographs of dried specimens of the great majority of the species known from China.

A specimen of *Polygonum calcatum*, Lind., gathered on Arthur's Seat, Edinburgh, was shown on behalf of C. E. MOSS, D.Sc., this being a new record for Great Britain for this plant.

Mr. R. C. DAVIE gave an account of a new locality near Eisenach, Germany, for *Teucrium montanum*, Linn., which is generally distributed over Central Europe and Asia Minor.

A collection of interesting plants in flower was shown from the Royal Botanic Garden:—

Of Primulas—*P. Bulleyana*, G. Forrest; *P. Forrestii*, Balf. fil.; *P. geraniifolia*, Hook. fil.; *P. lichiangensis*, G. Forrest; *P. luteola*, Rupr.; *P. membranifolia*, Franch.; *P. pinnatifida*, Franch.; *P. sino-listeri*, Balf. fil.; *P. sinomollis*, Balf. fil. (a new introduction raised by Mr. J. C. Williams from seeds collected by Mr. George Forrest in Yunnan); *P. Veitchii*, Duthie; also the two beautiful hybrids *P. Edina* (*Bulleyana* × *Beesiana*) and *P. Inverleith* (*Bulleyana* × *pulverulenta*).

Of Meconopsis—*M. aculeata*, Royle; *M. Delavayi*, Franch. (a new introduction flowered for the first time in cultivation, raised from seed collected by Mr. George Forrest for Bees, Ltd.); *M. grandis*, Prain (one of the few perennial species); *M. Henrici*, Bur. et Franch. (the plant came to Edinburgh from the Royal Gardens, Kew, and this is probably the first flowering in cultivation); *M. horridula*, Hook. fil. & Thoms.; *M. punicea*, Maxim.; *M. racemosa*, Prain; *M. rudis*, Prain; *M. simplicifolia*, Walp.; *M. sinuata*, Prain, var. *racemosa*; *M. Wardii*, Prain (a new species flowered for the first time in cultivation, raised from seed collected by Mr. Kingdon Ward for Bees, Ltd.).

Also the interesting Japanese plant *Pteridophyllum racemosum*, Sieb. et Zucc., a curious fumariaceous plant with pinnatisect fern-like leafage and spray of white flowers.

JUNE 12, 1913.

Sir ARCHIBALD BUCHAN-HEPBURN, Bart., in the Chair.

Mr. JAMES FRASER exhibited *Lychnis Preslii*, Sekera, and other plants from the Lothians (see p. 183).

Dr. MALCOLM WILSON exhibited specimens from Forfarshire of leaf spot or shot hole disease of the plum caused by *Cylindrosporium Padi*, Karst.

Mr. W. W. SMITH showed specimens of *Astragalus orotrephe*, a new species from the Tibetan frontier (see p. 178).

PROCEEDINGS
OF THE
BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXVIII.

NOVEMBER 13, 1917.

SYMINGTON GRIEVE, Esq., in the Chair.

The following gentlemen were elected Office-Bearers for the Session :—

PRESIDENT.

R. STEWART MACDOUGALL, M.A., D.Sc.

VICE-PRESIDENTS.

T. BENNET CLARK, C.A.
SYMINGTON GRIEVE, Esq.

W. G. SMITH, Ph.D.
JAMES WHYTOCK, Esq.

COUNCILLORS.

A. W. BORTHWICK, D.Sc.
Sir ARCHIBALD BUCHAN-
HEPBURN, Bart.
ALEXANDER COWAN, Esq.
CECIL B. CRAMPTON, M.B., C.M.
R. C. DAVIE, M.A., B.Sc.

JAMES FRASER, Esq.
JAMES GRIEVE, Esq.
J. RUTHERFORD HILL, Esq.
HARRY SANDERSON, Esq.
MALCOLM WILSON, D.Sc., F.L.S.

Honorary Secretary—W. W. SMITH, M.A.

Curator of Herbarium—W. CALDWELL CRAWFORD, M.A., F.R.S.E.

Foreign Secretary—Rev. D. PAUL, M.A., LL.D.

Treasurer—RICHARD BROWN, C.A., 23 St Andrew Square.

Assistant-Secretary—J. T. JOHNSTONE, M.A., B.Sc.

Artist—Professor FRANCIS M. CAIRD, M.B., C.M., F.R.C.S.E.

Auditor—ROBERT C. MILLAR, C.A.

LOCAL SECRETARIES.

Aberdeen—Professor J. W. H. TRAIL, M.A., M.D., F.R.S., F.L.S.

Bathgate—ROBERT KIRK, M.D., F.R.C.S.E.

Berwick-on-Tweed—FRANCIS M. NORMAN, R.N.

Birmingham—W. H. WILKINSON, F.L.S., F.R.M.S., Manor Hill, Sutton Coldfield.

Calcutta—Professor S. C. MAHALANOBIS, B.Sc., F.R.S.E., F.R.M.S., Presidency College.

Cambridge—ARTHUR EVANS, M.A.

Croydon—A. BENNETT, A.L.S.

Dundee—Professor P. GEDDES, F.R.S.E.

East Liss, Hants—JAMES SYKES GAMBLE, M.A., C.I.E., F.R.S.

Glasgow—Professor F. O. BOWER, Sc.D., F.R.S., F.L.S.

London—WILLIAM CARRUTHERS, F.R.S., F.L.S.

„ J. F. DUTHIE, B.A., F.L.S.

„ E. M. HOLMES, F.L.S., F.R.H.S.

„ Lieut.-Col. Sir DAVID PRAIN, M.D., C.I.E., F.R.S., F.L.S., Royal Botanic Gardens, Kew.

Melrose—W. B. BOYD, of Faldonside.

Otago, New Zealand—Professor JAMES GOW BLACK, D.Sc., University.

Philadelphia, U.S.A.—Professor JOHN M. MACFARLANE, D.Sc., F.R.S.E.

St Andrews—Professor M'INTOSH, M.D., LL.D., F.R.S.E.

„ ROBERT A. ROBERTSON, M.A., B.Sc.

„ J. H. WILSON, D.Sc., F.R.S.E.

Toronto, Ontario—The Hon. W. R. RIDDELL, B.Sc., B.A.

„ Professor RAMSAY WRIGHT, M.A., B.Sc.

Vancouver—M'TAGGART COWAN, Esq.

Dr. JAMES STIRTON was elected a Resident Fellow.

A motion by the Honorary Secretary, seconded by Mr RUTHERFORD HILL, “that only two of the Winter Meetings be held in the afternoon instead of three as at present” was carried unanimously.

The Hon. Secretary gave notice of the following motion on Alteration of Laws: That Chap. II. paragraph 1 be altered to read “A Meeting of the Society shall be held on the Second Thursday of every month from October to June inclusively.”

The CHAIRMAN announced the death since the previous meeting of Mr ROBERT LINDSAY, who had been elected an Associate in 1879 and a Resident Fellow in 1883.

A paper was read on behalf of the Hon. W. R. RIDDELL giving an account of the pharmacopœia of the botanical physician eighty years ago (see p. 226).

Mr. W. W. SMITH gave an account of the vegetation of Sikkim, illustrated by numerous lantern slides.

Mr. JAMES FRASER showed specimens of *Linaria rubrifolia*, Rob. et Cast., *Ammochloa pungens*, Desf., *Vulpia cynosuroides*, Boiss., *Arrhenatherum erianthum*, Boiss. et Reut., from Midlothian; and *Symphytum peregrinum*, Ledeb., from nine Scottish counties (see p. 234).

Specimens of *Bryum atlanticum*, Solms., were exhibited on behalf of Dr. STIRTON, which he had obtained last year at Plockton, Ross-shire, a new record for Great Britain.

Mr. R. C. DAVIE showed specimens of *Inula Helenium*, Linn., a new record for Mull.

The following living plants in flower were shown from the Royal Botanic Garden:—

Alternanthera paronychioides, St. Hil.: a South American plant of creeping habit and small green foliage. *Buddleia asiatica*, Lour.: a not quite hardy species, with fragrant white flowers and smallish silvery foliage, from subtropical Asia. *Dracocephalum tanguticum*, Maxim: this species from China is perhaps one of the best autumn plants for its profusion of bloom, and is suitable either for the rockery or border. *Euryops virginicus*, Less., South Africa: a tender shrub, hardy in Cornwall and the Scilly Islands, flowering out of doors at Edinburgh. *Genista salditana*, Pomel: an Algerian plant requiring protection in the north, but perhaps hardy in the southern parts of the country. *Gentiana rhodantha*, Franch.: of good bushy habit and a vigorous grower; the flowers are of a pinky-white colour, with a fringed corolla; Yunnan. *Hydrocotyle hirsuta*, Sw.: a peculiar umbellifer from the island of St. Domingo. *Jasminum lineare*, R. Br.: a rather pretty plant with fine foliage and white flowers. *Lepidium piscidium*, Forst. f.: a plant from the Pacific Islands said to be used by the natives for catching fish; the plant

itself was raised from seed obtained on Henderson Island. *Lobelia puberula*, Michx., North America: a late flowering species with blue flowers. *Saxifraga cinerascens*, Engler et Irmscher: a doubtfully hardy species from Yunnan with yellow flowers. *Saxifraga turfosa*, Engler et Irmscher: somewhat like *S. diversifolia*, Wall., with yellow flowers, but propagating itself by stolons; Yunnan.

DECEMBER 11, 1913.

R. STEWART MACDOUGALL, M.A., D.Sc., in the Chair.

The TREASURER, Mr RICHARD BROWN, C.A., submitted the following Statement of Accounts for the Session 1912-1913:—

INCOME.

Annual Subscriptions for 1912-1913	£35	5	0
Do. Arrears	3	15	0
Transfer from Life Members' Fund	7	15	5
"Transactions" sold	5	4	0
Subscriptions to Illustration Fund	2	0	0
Interests on Deposits in Bank	6	4	0
Excess of Expenditure over Income	21	15	5
	£81	18	10

EXPENDITURE.

Printing "Transactions" for 1912-13 (estimate), £33, and reprinting "Transactions" for 1911-12, £24, 12s., less contribution of £5 towards cost of same	£52	12	0
Printing Notices for Meetings, etc.	10	4	6
Rooms for Meetings and Tea	6	10	0
Stationery, Postages, Carriages, etc.	2	7	4
Fire Insurance on Books, etc.	0	5	0
Honorarium to Acting Secretary	10	0	0
	£81	18	10

STATE OF FUNDS.

Life Members' Fund.

Balance of Fund at close of Session 1911-1912	£89 2 3
Add—Life compositions received	21 0 0
	<hr/>
	£110 2 3
Deduct—Transferred to Income	7 15 5
	<hr/>
Balance as at close of Session	£102 6 10

Ordinary Fund.

Balance of Fund at close of Session 1911-1912	£69 3 11
Deduct—Decrease during Session 1912-1913	21 15 5
	<hr/>
Balance as at close of Session	47 8 6
	<hr/>
Total Funds	£149 15 4
Being:—Sum in Current Account with Union Bank of Scotland Ltd.	£30 3 0
Sums in Deposit Receipt with do.	190 0 0
Due by Treasurer	7 8 10
	<hr/>
	£227 11 10
Less—Accounts unpaid at 31st October 1913	77 16 6
	<hr/>
As above	£149 15 4

Note.—Subscriptions in arrear, 1910-11, £3; 1911-12, £3; 1912-13, £6, 5s.

EDINBURGH, 5th December 1913.—I hereby certify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for Session 1912-1913, and have found them correct. I have also checked the foregoing Abstract, and find it correct.

ROBT. C. MILLAR, C.A., Auditor.

Mr. THOMAS ANDERSON and Mr. T. M. FINLAY were elected Resident Fellows.

A motion by the HON. SECRETARY, seconded by Mr. JAMES FRASER, "that the two afternoon meetings of the Winter Session be held in December and January," was carried unanimously.

The following motion on Alteration of Laws by the HON. SECRETARY, seconded by Mr. JAMES FRASER, was carried unanimously:—Chap. II., Ordinary Meetings. That

paragraph 1 be altered to read: "A Meeting of the Society shall be held on the second Thursday of every month from October to June inclusively."

Dr. W. G. SMITH gave some notes on Danish vegetation, illustrated with numerous lantern slides.

Mr. M. Y. ORR showed specimens of the leaf insect *Pulchriphylum crurifolium*, Serv., and gave notes on its habits

Dr. R. S. MACDOUGALL exhibited some Ceylon insects injurious to tea, rubber, and coffee.

On behalf of Miss HAYWARD, specimens were exhibited of the hybrids *Rosa spinosissima* \times *Eglanteria* from Roxburgh, and *Rosa spinosissima* \times *tomentosa* from Selkirk.

On behalf of Mr. JOHN ROSEBURGH, specimens were exhibited of *Epilobium alsinoides*, A. Cunn., a New Zealand plant which he had gathered at Galafoot in 1913, a new record for Great Britain.

From the Royal Botanic Garden living plants in flower were shown of:—

Gentiana rigescens, Franchet: a sturdy grower of a bushy habit, with persistent stems and foliage. The flowers are of a violet pink colour. Very floriferous, and a late blooming species worthy of being better known. Yunnan.

Spathoglottis edlinensis \times , Rolfe: raised at the Royal Botanic Garden from seed procured by crossing *S. Fortunei*, Lindl., and *S. pulchra*, Schlechter.

Mr. SYMINGTON GRIEVE exhibited a piece of wood showing the ravages of the beetle *Anobium domesticum*.

JANUARY 15, 1914.

R. STEWART MACDOUGALL, M.A., D Sc., in the Chair.

The PRESIDENT announced that His Majesty King George had been graciously pleased to become Patron of the Society.

Mr. SYDNEY LATIMER was elected a Resident Fellow.

Mr. HARRY SANDERSON gave an account of a visit to the Prenj Planina in Herzegovina, with some notes on the vegetation of the district.

Col. H. H. JOHNSTON, C.B., read two papers: "Additions to the Flora of Orkney," as recorded in Watson's *Topographical Botany*, 2nd edition (see p. 207), and "Notes on some Rare or Interesting Orkney Plants," which he illustrated with photographs and dried specimens (see p. 217).

Mr. W. W. SMITH gave a note on *Rhododendron cyanocarpum*, Franch. (see p. 274).

FEBRUARY 12, 1914.

R. STEWART MACDOUGALL, M.A., D.Sc., in the Chair.

Mr. DONALD MACPHERSON, Mr. ALEXANDER MACPHERSON, and Dr. JOHN MACWATT were elected Resident Fellows.

Mr. MONTAGU DRUMMOND gave an account of a summer vacation in Jamaica, with lantern illustrations, with special reference to the Botanic Gardens at Hope, near Kingston, at Castleton, twenty miles inland, and at Cinchona in the Blue Mountains at an altitude of 5000 ft. He pointed out the special advantages of Cinchona as a tropical station for research, and drew attention to the project which is on foot to make that station more fully available to British students.

Miss LAMONT read a paper on the Ecology of the Estate of Knockdow, with lantern illustrations (see p. 248).

Dr. R. S. MACDOUGALL exhibited the Citrus White Fly (*Aleyrodes citri*) parasitised by the Red Fungus (*Aschersonia abyrodidis*) and the Black Fungus (*Aegerita Webberi*).

Mr. WHYTOK showed a collection of flowers gathered that morning from shrubs growing in the open at Dalkeith Palace Gardens, including species of *Hamamelis* and *Chimonanthus fragrans*, Lindl.

The following living plants in flower were shown from the Royal Botanic Garden :—

Cullumia setosa, R. Br.: a peculiar South African composite. *Rhododendron moupinense*, Franch.: a very nice dwarf free-flowering species suitable for the rockery and producing large whitish flowers (sometimes spotted) in the middle of a Scottish February. Introduced from Western China by Veitch's collector, E. H. WILSON. *Rhododendron oleifolium*, Franch.: also a hardy species with whitish flowers tinged sometimes with lilac. Also brought from Western China by E. H. WILSON.

MARCH 12, 1914.

W. G. SMITH, Ph.D., in the Chair.

The CHAIRMAN intimated the death since the previous meeting of ARTHUR E. DAVIES, Ph.D., F.L.S., a Resident Fellow and former Office Bearer.

Dr. W. BALFOUR GOURLAY gave some notes on the trees and flowers of British Columbia and Washington, illustrating his remarks by numerous lantern slides of the vegetation of the Rocky and Selkirk mountains and of the district round Mt. Olympus and Mt. Rainier.

Mr. M. Y. ORR read a paper on the occurrence of *Pitularia globulifera*, Linn., in Glamorganshire (see p. 281).

Dr. BORTHWICK communicated a paper by Mr. W. S. JONES on Photomicrography as applied to Timber Study (see p. 235).

The following interesting plants in flower were shown from the Royal Botanic Garden :—

Ribes Henryi, Franch.: male plants of this species in good flower. *Androsace Delavayi*, Franch.: a pretty species forming dense cushions and bearing numerous pink and sweetly scented flowers just above the foliage. *Rhododendron Hanceanum*, Hemsl.: a pale yellow-flowered Chinese species which is very floriferous in the

young state. *Primula Inayati*, Duthie: a North-west Himalayan plant nearly allied to *P. purpurea*. *Pernettya furens*, Klotzsch.: a hardy Chilian shrub suitable for the rockery.

APRIL 9, 1914.

R. STEWART MACDOUGALL, M.A., D.Sc., in the Chair.

Mr. A. SCOTT DODD was elected a Resident Fellow.

Mr. E. J. A. STEWART and Mr. DONALD PATTON read a paper on the Flora of the Culbin Sands.

A paper was read on behalf of Dr. STIRTON on Additional Mosses from West Ross-shire (see p. 241).

Mr. W. W. SMITH read papers on an Himalayan variety of *Plumbagella micrantha*, Spach (see p. 277), and on a tuberous *Senecio* from China (see p. 279).

Dr. BORTHWICK exhibited specimens of *Nectria cucurbitula*, Fr., which is known to do considerable damage to spruce plantations on the continent, and whose distribution seems to be fairly general in the midlands of Scotland.

The following plants in flower were shown from the Royal Botanic Garden:—

Rhododendron fastigiatum, Franch.: a dwarf plant of a few inches in height with small foliage and bright purple flowers about half an inch in diameter. *Rhododendron lutescens*, Franch.: a yellow-flowered species of shrubby habit, with bronzy foliage, also from China. *Rhododendron Davidsonianum*, Rehder et Wilson. *Rhododendron polylepsis*, Franch. *Roettlera Forrestii*, Diels.: an interesting Gesnerad of neat habit with hairy foliage and yellow flowers. *Primula redolens*, Balf. fil.: a new species of the section *Suffruticosae*, closely allied to *P. Forrestii*, Balf. fil.: this was raised at the Royal Botanic Garden, Edinburgh, from seed presented by A. K. Bulley, Esq., collected by F. Kingdon Ward on the borders of China and Tibet.

MAY 14, 1914.

R. STEWART MACDOUGALL, M.A., D.Sc., in the Chair.

The PRESIDENT announced the death since the previous meeting of M. Philippe van Tieghem, one of the Society's Honorary Foreign Fellows.

Mr. ALEX. COWAN read the Report of the Scottish Alpine Botanical Club for 1913 (see p. 287).

Dr. R. S. MACDOUGALL exhibited specimens of *Chelura terebrans* and *Linnoria lignorum*, and of wood damaged by them.

Specimens of a species of *Ribes* were shown from The Wold, Hawick. This species, last year, from its fruit, was taken to be a hybrid between a gooseberry and a black-currant. Mr. BENNET CLARK did not agree with this view, one reason being that the plants at The Wold had been established there for sixty or seventy years. On examination of the flowers this year Mr. BENNET CLARK identified the plant as *Ribes divaricatum*, Dougl., a North American species introduced into Great Britain about 1830, and figured in the Botanical Register. In the discussion which followed this determination was confirmed.

Dr. WILSON and Mr. J. M. COWAN exhibited specimens of *Cromatium Okenii*, Ehrh., one of the Sulphur Bacteria.

JUNE 11, 1914.

R. STEWART MACDOUGALL, M.A., D.Sc., in the Chair.

Miss R. CROSSE read a paper on Variations in the Growing Region of Root and Shoot (see p. 289).

Miss F. M. SCOTT read a Note on Phyllody and Diatropism in the Primrose (see p. 296).

Mr. L. B. STEWART gave an account of some experiments on imbricate-leaved *Veronicas*.

The HON. SECRETARY communicated a paper by Dr. A. K. SCHINDLER giving a description of two new *Leguminosae* (see p. 285).

Dr. BORTHWICK exhibited specimens of *Chrysomyxa Rhododendri*, De Bary, on the spruce, a new record for Scotland.

On behalf of Mr. G. G. BLACKWOOD, a note was read recording the finding of *Vaccinium uliginosum*, Linn., on the hill plateau to the south of the Talla district in Peeblesshire.

Dr. MALCOLM WILSON exhibited specimens of *Puccinia Prostii*, Maug., attacking the leaves of *Tulipa sylvestris*, Linn., from the Royal Botanic Garden, Edinburgh. *Puccinia Prostii* has been recorded only once before from Britain by MASSEE in 1913, who discovered it on cultivated tulips in England. Only teleutospores have up to the present been found in this fungus, but the specimens exhibited contained numerous spermatogonia of normal structure in addition to the teleutospores.

PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXIX.

OCTOBER 7, 1914

R STEWART MACDOUGALL, M.A., D.Sc., in the Chair

The following gentlemen were elected Office-Bearers for the Session :—

PRESIDENT.

R STEWART MACDOUGALL, M.A., D.Sc.

VICE-PRESIDENTS.

ALEXANDER COWAN, Esq
JAMES FRASER, Esq

SYMINGTON GRIEVE, Esq
JAMES WHYTOOK, Esq

COUNCILLORS.

A. W. BORTHWICK, D.Sc.
SIR ARCHIBALD BUCHAN-
HEPBURN, Bart
T. BENNET CLARK, C.A.
R. C. DAVIE, M.A., B.Sc.
JAMES GRIEVE, Esq

J. RUTHERFORD HILL, Esq
HARRY SANDERSON, Esq
W. G. SMITH, Ph.D.
JEAN G. THOMPSON, B.Sc.
MALCOLM WILSON, D.Sc., F.L.S.

Honorary Secretary—W. W. SMITH, M.A.
Operator of Herbarium—W. CALDWELL CHAWFORD, M.A., F.R.S.E.
Foreign Secretary—Rev D. PAUL, M.A., LL.D.
Treasurer—PETER BROWN, C.A., 23 St Andrew Square.
Assistant Secretary—J. T. JOHNSTONE, M.A., B.Sc.
Librarian—Professor FRANCES M. CAIRD, M.B., C.M., F.R.C.S.E.
Secretary of the Edinburgh Botanical Club—G. MILLAR, C.A.
Secretary of the Edinburgh Botanical Club—G. MILLAR, C.A.

LOCAL SECRETARYS

- Aberdeen—Professor J. W. H. TRAIL, M.A., M.D., F.R.S., F.R.S.E.
 Belfast—ROBERT KIRK, M.D., F.R.C.S.E.
 Bristol & Leeds—FRANCIS M. NORMAN, B.N.
 Birmingham—W. H. WILKINSON, F.L.S., F.R.M.S., Manor Hill, Edgbury, Coldfield.
 Calcutta—Professor S. C. MAHALANOBIS, B.Sc., F.R.S.E., F.R.M.S., Presidency College.
 Cambridge—ARTHUR EVANS, M.A.
 Cheydon—A. BENNETT, A.L.S.
 Dundee—Professor P. GEDDEN, F.R.S.E.
 East Looe, Hunts—JAMES SYKES GAMBLE, M.A., C.I.E., F.R.S.
 Glasgow—Professor F. O. BOWER, Sc.D., F.R.S., F.L.S.
 London—WILLIAM CARRUTHERS, F.R.S., F.L.S.
 " J. F. DUTHIE, B.A., F.L.S.
 " E. M. HOLMES, F.L.S., F.R.H.S.
 " Lieut.-Col. SIR DAVID PRAIN, M.D., C.I.E., F.R.S., F.L.S., Royal Botanic Gardens, Kew.
 Melrose—W. B. BOYD, of Faldonside.
 Philadelphia, U.S.A.—Professor JOHN M. MACFARLANE, D.Sc., F.R.S.E.
 St. Andrews—Professor M. INTOSH, M.D., LL.D., F.R.S.E.
 " ROBERT A. ROBBLETON, M.A., B.Sc.
 " J. H. WILSON, D.Sc., F.R.S.E.
 Toronto, Ontario—The Hon. W. R. RIDDELL, B.Sc., B.A.
 " Professor RAMSAY WRIGHT, M.A., B.Sc.
 Vancouver—M. TAGGART COWAN, Esq.

Mr. DONALD PATTON and Mr. EDWARD J. A. STEWART were elected non-Resident Fellows.

Miss ISA MARTIN was elected a Resident Fellow.

Mr. JAMES FRASER communicated a note on the occurrence of *Megastigmus prui*, Parf., in the seeds of *Abies nobilis*, Lindl. (see p. 405).

A paper on the Saxifrages of the Diptera section was read on behalf of Professor BAYLEY BALFOUR and illustrated with photographs of living plants and of the type sheets.

Mr. JAMES FRASER gave notes on certain Scottish plants which he illustrated with specimens of his own collecting (see p. 404).

On behalf of Mr. M. Y. ORR, a new species of *Aschmannia* (*A. chorisepala*) from China was exhibited.

Mr. JAMES H. ANDREW gave an account of two plants which had not been recorded definitely before from Great Britain—*Asperula borealis*, Thell., and *Puccinia septentrionalis*, Don.—both on *Thalictrum alpinum*, Linn.

Mr. JAMES H. ANDREW showed a specimen of *Symphytum asperum*, Donn, from East Lothian.

A new genus of *Ranunculaceae* found on the borders of Tibet and China and named *Kingdonia* was exhibited by Professor BAYLEY BALFOUR and Mr. W. W. SMITH.

A collection of some twenty new species from West China collected by Mr. GEORGE FORREST was shown. The collection included interesting examples of the genera *Clematis*, *Impatiens*, and *Styrax*.

NOVEMBER 12, 1914

R. STEWART MACDOUGALL, M.A., D.Sc., in the Chair

The TREASURER, Mr. RICHARD BROWN, C.A., submitted the following Statement of Accounts for the Session 1913-1914.—

INCOME

Annual Subscriptions for 1913-1914	£36 15 0
Do. Arrears	1 15 0
Transfer from Life Members' Fund	8 2 9
"Transactions" sold	14 19 4
Subscriptions to Illustration Fund	1 5 0
Interest on Deposits in Bank	4 8 1
Excess of Expenditure over Income	10 19 7
	<u>£78 4 9</u>

EXPENDITURE

Printing "Transactions" for 1912-1913, £42, 3s. 10d., less provided in last year's accounts £33, and "Transactions" for 1913-1914, £36, 17s.	£46 0 10
Printing Notices for Meetings, etc.	10 0 6
Room for Meetings and Tea	6 10 0
Light & Lantern	2 2 0
Postage, Fares, Carriages, etc.	3 5 5
Cost of Journals or Books, etc.	0 5 0
Stationery for Acting Secretary	10 0 0
	<u>£78 4 9</u>

Receipts & Funds.

Life Members Fund.

Balance of Fund at close of Session 1912-1913	£102 8 10
Add—Life compositions received	7 8 0
	<hr/>
	£109 13 10
Deduct—Transferred to Income	8 2 0
	<hr/>
Balance as at close of Session	£101 11 1

Ordinary Fund.

Balance of Fund at close of Session 1912-1913	£47 8 6
Deduct—Decrease during Session 1913-1914	10 19 7
	<hr/>
Balance as at close of Session	36 8 11
	<hr/>
Total Funds	£138 0 0
Being—Sum in Current Account with Union Bank of Scotland Ltd	£29 14 3
Sum in Deposit Receipt with do	150 0 0
	<hr/>
	£159 14 3
Less—Due to Treasurer	£11 14 3
Due to acting Secretary	10 0 0
	<hr/>
	21 14 3
	<hr/>
As above	£138 0 0

Note.—Subscriptions in arrear, 1912 1913, £1, 10s. ; 1913-1914, £5, 5s

EDINBURGH, 5th November 1914—I hereby testify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for Session 1913-1914, and have found them correct I have also checked the foregoing Abstract, and found it correct

ROBT O MILLAR, C A , Auditor

Mr. J H. ALEXANDER and Mr. JAMES L S. SMITH were elected Resident Fellows.

Mr. ANDREW HARLEY was elected a non-Resident Fellow.

Dr. R. S. MACDOUGALL gave his Presidential Address (to be published in a subsequent issue).

A paper on William Arthur, M.D., was communicated on behalf of Professor BAYLEY BALFOUR (see p. 375).

Mr. R. C. DAVIE exhibited an interesting series of *Podostomaceae* from Ceylon and Brazil.

DECEMBER 10, 1914.

R. STEWART MACDOUGALL, M.A., D.Sc., in the Chair.

Mr. R. C. DAVIE gave an account of a botanical tour in Brazil, in the neighbourhood of Rio de Janeiro, and illustrated the description with numerous lantern slides.

Dr. R. S. MACDOUGALL gave a note on the Giant Wood Wasp, *Sirex gigas*, Linn., as a feeder on chocolate

British *Armerias* from the Herbarium of the Royal Botanic Garden were exhibited illustrating a possible new species, *A. scotica*, C. Reid, mss.

An anomalous Thymelineous plant from China allied to *Wikstroemia* was also shown from the Herbarium of the Royal Botanic Garden.

Mr. W. W. SMITH exhibited a new species of *Alangium* (*A. kinabaluense*) from Mt. Kinabalu, Borneo

JANUARY 14, 1915

R. STEWART MACDOUGALL, M.A., D.Sc., in the Chair

Mr. ALLAN ARNOLD PINKERTON was elected a Resident Fellow.

Dr. W. G. SMITH exhibited papier-maché models illustrating the distribution of peat, heather, and other plants in the south of Scotland.

Dr. MALCOLM WILSON demonstrated a method of inspecting micro-organisms by means of which the real shape is shown more effectively than by the usual methods

Dr. R. S. MACDOUGALL exhibited an imported wood-block with an alien beetle.

A paper on *Hydrilla verticillata*, Caspary, in Great Britain, was read on behalf of Mr. ARTHUR BENNETT (see p. 422).

A paper was read on behalf of the Hon. W. H. STODOLSKY giving an account of the Pharmacopoeia of the Bohemian Physician eighty years ago (second paper) (see p. 411).

FEBRUARY 11, 1915.

T. BENNET CLARK, Esq., in the Chair.

Mr. DONALD PATTON read a paper on Some Norwegian Plant Associations, in which he dealt with observations made during a tour in Norway in the previous July. The various plant associations were discussed chiefly in connection with the respective floras of the localities, Voss, Finse, Myrdal, and Balholm. At Voss the flora was very similar to that of certain parts of Scotland. The Finse flora was typically alpine, but not arctic. Both alpine and lowland plants were found at Myrdal and Balholm.

An interesting Bornean plant, *Clerodendron fistulosum*, Becc., was shown by Mr. H. F. TAGG, the stems of which are hollow and inhabited by a species of ant, *Colobopsis Clerodendri*, Emery.

On behalf of Colonel H. H. JOHNSTON a series of the rarer Orkney plants was exhibited, some of which were new records for Orkney.

Flowers and nectar-sacs of *Marcgravia myriostigma*, Fr. et Cl., were exhibited by Mr. R. C. DAVIE.

Mr. W. W. SMITH showed a peculiar form of *Patentilla ambigua*, Camb., which from appearance might have been grown by the side of a waterfall.

MARCH 11, 1915.

JAMES WHITLOCK, Esq., in the Chair.

Mrs. A. S. M. ALEXANDER was elected a Resident Fellow.

Dr. BAYLEY BALFOUR read a lecture paper on his Botanical Notes in Brazil, dealing chiefly with Forest, Scrub, and Savanna. He described the chief features of the rain-forest of the coast "Serras" at Rio de Janeiro and Santos, of the "Serra" at Petropolis, and of the awesome Organ Mountains. Lantern-slides were shown to illustrate the flora of the forest, the coast "restingas" or sand-banks, and the dry elevated plateau of the interior. Reference was made to the methods of travel, the native system of agriculture, and the almost untouched mineral and botanical wealth of the country.

A new and peculiar genus *Moultonia* was exhibited by Professor BAYLEY BALFOUR and Mr. W. W. SMITH. The plant above ground consists of a single large leaf and the flowers arise in the furrow of the leaf-stalk and in the furrow of the mid-rib of the leaf.

Dr. MALCOLM WILSON exhibited the Rust Fungus *Uromyces onobrychidis*, Lév. The fungus which was collected in Kent has not been previously recorded for Britain.

Dr. WILSON also exhibited *Euphorbia Pseudo-cyparissias*, Jord., a variety of *Euphorbia Esula*, Linn., as a casual in the same country.

APRIL 8, 1915.

R. STEWART MACDOUGALL, M.A., D.Sc., in the Chair.

A communication was read on behalf of Dr. JAMES STAXON, dealing with some new species of mosses which he had obtained in West Ross-shire (see p. 423).

A new genus of *Ranunculaceae* from the borders of Burma and China was exhibited by Professor BAYLEY BALFOUR and Mr. W. W. SMITH. The name given to this new genus, *Paesia*, is in honour of the well-known firm of Messrs. Paes & Co., whose enterprising collector, Mr. F. KINGDON, discovered the plant last year.

Dr. MALCOLM WILSON exhibited a rare fungus which attacks the flowers of *Primula*—*Puccinia primulae* Kuhn. This fungus has only been found once previously, and that in Germany.

Dr. WILSON also exhibited early stages of the so-called bacterial disease of ash, and *Sphaerocarpus terrestris*, Mich., a rare British hepatic.

A very peculiar fasciation in *Gypsophila* was exhibited by Mr. H. F. TAGG.

Dr. R. S. MACDOUGALL exhibited some insect pests of timber.

MAY 12, 1915

R. STEWART MACDOUGALL, M.A., D.Sc., in the Chair.

Dr. MALCOLM WILSON showed an important disease of the Scots pine—*Dasyscypha subtilissima*, Cooke.

Mr. JAMES FRASER showed specimens of *Fumaria Bastardi*, Bor., a new record for Midlothian.

Dr. A. W. BORTHWICK exhibited peculiar larch cones, showing great abnormality of growth.

Mr. H. F. TAGG showed malformations on the flowers of the ash caused by *Eriophyes fraxini* (Karp.), Nal.

Mr. TAGG also exhibited specimens showing the damage done to telegraph poles by wood-peckers.

Sir ARCHIBALD BUCHAN-HEPBURN showed a fine form of *Berberis Darwinii*, Hook., which was raised from a seedling; also a flowering branch of *Sophora tetraptera*, F. Müll.

Mr. WHYTOCK showed a branch of a rare larch—*Larix dahurica*, Turcz.

JUNE 10, 1915.

R. STEWART MACDOUGALL, M.A., D.Sc., in the Chair.

Mr. ALEX. COWAN read the Report of the Scottish Alpine Botanical Club for 1914 (see p. 429).

Mr. H. A. ROBERTSON and Miss S. J. WILKIE contributed a paper on a New Method of Automatic and Continuous Registration of Transpiration (see p. 432).

Dr. MALCOLM WILSON exhibited *Hapalosphaeria deformans*, Syd., from near Aberlady, a rare fungus recorded for the first time in this country.

Sir ARCHIBALD BUCHAN-HEPBURN showed a yellow-flowered seedling of *Cytisus praecox*, all the other seedlings being white like the parent plant.

TRANSACTIONS
OF THE
BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXVI.

PRESIDENTIAL ADDRESS.—SOME MODERN ASPECTS OF
APPLIED BOTANY. By A. W. BORTHWICK, D.Sc.

ALL progress of nations and increase in population is preceded by the discovery of some new natural resource or by a new use of a previously known one. Science is the working force which leads to increase of knowledge and industrial progress. Industries increase, but natural resources are in danger of exhaustion. The average man demands more and more, and his needs increase with civilisation and industrial progress; hence at the present day he must study, investigate, and learn how to utilise the natural resources with the greatest economy; and as man demands more from Nature, she in turn demands more from man. He must learn how to care for his crops more scientifically, to increase their yield, and also to conserve and improve the soil. In what way can the natural resources be best and most economically utilised? The obvious answer is by studying them in a scientific manner in order that we may learn how to utilise them in a scientific way. In the realms of science botany stands out pre-eminently as the science which comes into the most intimate contact with the fundamental problems of life and living things. It is at the same time the science which lends itself most readily to practical application in many economic directions. Plants may be studied in a

purely scientific spirit—that is, to increase the sum of human knowledge in the endeavour to satisfy the mind regarding the problems of life and existence. Impelled by his natural curiosity, man is always investigating, always discovering, and always discovering more to be discovered.

The study of plants and the operations of the laws of nature is of direct value as a humanising influence upon mankind; but when we can apply the knowledge so gained to some practical, economic purpose, we add not only to the usefulness but also to the dignity of the science.

Investigations pursued with a practical or economic object in view have in the past many times incidentally led to the elucidation of problems of interest in pure science, and, on the other hand, discoveries of the greatest technical importance have been made by men engaged in pure science investigation. It is impossible to separate the investigation of pure science from that of applied science, and every day the opinion is gaining ground that there is nothing derogatory to science in its application to the arts and industries. In pure and applied biological science, and, indeed, in all science, there should be a common meeting-ground between the scientist and the practical man. In forestry, agriculture, and horticulture the practical man comes daily in contact with phenomena of diverse kinds, and in time he comes to know a large number of isolated facts, the meaning of which he is apt to misunderstand or to misinterpret. Had the practical man a little more science, or if the scientific man came more into contact with him, much valuable knowledge would be gained on both sides, and much time and money saved.

This fact is clearly recognised by our Society, as the following extract from its general views and objects shows:—

“The attention of the Society is turned to the whole range of Botanical Science, together with such parts of other branches of natural history which are immediately connected with it. These objects are cultivated:

“By holding meetings for the interchange of botanical information, for the reading of original papers or

translations, abstracts or reviews of botanical work, regarding any branch of botanical knowledge, practical, physiological, geographical, and palæontological, and the application of such knowledge to agriculture and the arts."

This is what led me to select as the theme of my address some practical aspects of applied botany.

In the whole range of botanical science, possibly oecology, physiology, and pathology are the three most important departments as applicable to the industries and arts.

The Society at the present time is strong in oecological experts, and has within the last year or two published several important communications bearing on oecological problems.

Regarding the introduction and cultivation of new plants of economic value, we find that this branch of economic botany has not received as much consideration and thought as its importance deserves. No doubt the world has been searched for plants of value in horticulture, and many trees, shrubs, and herbaceous plants of great ornamental value have been introduced, but no properly organised and systematic endeavour has been made to introduce and test new species of economic rather than of ornamental importance. Several of our large seed firms and many private individuals have rendered valuable service to the nation by the production of new and improved varieties of plants already in cultivation, and the recent science of Genetics is certain in the near future to enable man to produce with greater rapidity and certainty plants of improved quality. It is, however, not only necessary to discover or to artificially produce new varieties: we must go further, and test the suitability of these new species and varieties under varying oecological conditions. Owing to the endless modification in soil and climate, it is not possible to formulate definite rules, and to say whether a variety which is a success in one place will do equally well in another. Still, by making an oecological study of a plant in its native habitat, we can form a very good opinion of how it will behave when introduced into new conditions. A knowledge of a plant's oecological characteristics enables us to select those conditions of

locality and environment which are most likely to supply its requirements. At the same time it is only by actual trial or experiment that such questions can be definitely settled. We must apply to Nature direct for our information, and ask such questions by means of experiment, and note the reply she gives. I wish here to emphasise the fact that experiments based on scientific principles are likely to yield better and more valuable results than those conducted on blind trial and error, or rule of thumb methods. It is therefore essential that such trials should be carried out under expert supervision. It may be that some slight error in cultivation leads to failure; hence it is necessary to know in each case when failure occurs why it occurs, and, having found the cause, to try if anything can be done to ameliorate or modify the conditions to suit the plant. Otherwise, through some initial error or failure to select the proper cultural method, a plant might be lost which would otherwise have proved a valuable addition to the economic flora. It is in connection with such problems that the study of plant *œcology* will prove of great economic importance. In itself the study of plant *œcology*, or the geographical distribution of plants on a physiological basis, is of the highest scientific value; and when we can apply its results in a practical manner to the cultivation of plants, it assumes an economic value of equal merit.

As an illustrative example, let us for a moment consider Dr. Kienitz's important investigations into the shapes and types of the Scots pine, as it furnishes a splendid example of the value of *œcological* studies to a practical industry like forestry. He has shown that the tree occurs in several *œcological* forms, among which two well-marked *œcological* types can be readily distinguished. The one a strong-branched, strong-crowned tree, which is the typical form in Scotland; the other a slender, pyramidal-shaped tree, which is typical of the Baltic provinces. Such types are found to be hereditary, and are not altered by altered climate and soil. The Scottish type is better adapted to hold its own in the struggle for life in milder localities, whereas the slender, pyramidal type is better able to hold its own under more rigorous conditions, where wind, and especially heavy snowfalls, constitute the primary dangers.

Great care should therefore be exercised in selecting seed or in planting seedlings, of whichever form is better suited to a definite locality.

In many places in this country we have examples of the Alpine or northern form of the Scots pine planted where they have no business to be.

Plant Disease.—In applied botany there is no department of greater economic importance than that which deals with plant disease, *i.e.* plant pathology.

Plants of all kinds as living things are subject to disease. It is difficult to give a short, concise definition of disease. The following is a dictionary definition: "A derangement in the structure or the function of any organ belonging to a vegetable or animal," but this does not convey any definite or clear meaning. After all, probably it does not matter much whether we can in words draw up a hard and fast definition, as there is no hard and fast line of demarcation between health and disease. Let us for the present understand by disease any marked deviation of the vital functions from the normal. We may have various stages of healthiness, from the perfectly healthy body or organ, through less healthy conditions, till a diseased state is reached, and likewise we may have various stages of disease, from slight to severe. For health, the living body and its organs must be normal, and the environmental factors and conditions must approach as near the *optimum* in each case as possible. Otherwise, signs of unhealthiness may appear, probably not sufficient at the moment to cause much alarm to the practical cultivator, but the scientist knows that plants, even though slightly weakened, may have developed a predisposition to unhealthiness, and crops, though not actually diseased, may nevertheless be liable to an epidemic attack, the conditions for which may be made favourable through loss of vigour of the plants.

Loss of vigour and subsequent unhealthiness in plants may be caused by unfavourable environment. In the plant kingdom, as in the animal kingdom, unfavourable environmental conditions may be grouped under two heads, namely, physical and organic environment. The physical environment is supplied by the soil in all its variations of chemical composition, depth, porosity, moisture, temperature, texture,

air-content, etc. Then we have the atmospheric conditions, namely, temperature, moisture, precipitations, lighting, wind, etc., the conditions of soil and atmosphere; in other words, the climate varies with latitude, altitude, aspect, and exposure. Man has but little power to ameliorate the atmospheric conditions, but he often does the opposite by allowing air to become polluted by smoke and poisonous fumes, thus producing conditions highly inimical to plant life.¹ On the other hand, something may be done to ameliorate the soil conditions. For example, by draining, manuring, and cultivating. As regards altitude, exposure, and aspect, man can select and cultivate species or varieties in those localities or situations where each is likely to find its nearest approach to its *optimum* conditions.

The organic environment is supplied by the plant and animal kingdoms. In the vegetable kingdom we have plants in competition with one another for the best soil and air space. We have also the saprophytic and parasitic forms. The soil bacteria are not the least important members of the organic environment, although mentioned last.

The science of Mycology is of the greatest importance in pure and applied botany. Fungi play a very important rôle in nature as saprophytes and parasites. Many forms have by careful selection and cultivation been pressed into the service of man in such important industries as cheese-making, bread-baking, wine and cider preparation, brewing, distilling, etc.

The cultivated mushroom and the numerous wild edible forms, only too little known, have their importance as food plants. Finally, the study of the parasitic disease-causing forms is of the highest theoretical and economic importance.

Pure science in investigating the effect of disease aims at discovering the changes of the living substance and tissues. It may be called Cytopathology. Applied science considers the influence of disease on the plant as regards its economic value. We must combine both in order to understand the phenomenon from an economic standpoint.

¹ The question of smoke and fume damage to plants is receiving greater attention than ever on the Continent. Such damage has increased enormously with increasing industrial development.

The fungi, bacteria, and insect enemies of cultivated plants cause enormous damage and annual loss, not only to the cultivators of plants, but to the nation as a whole.

In Prussia the Phytopathological Commission gave in 1893 a striking example of the loss caused by grain-rust. The data were supplied by the Prussian Statistical Bureau, so that the figures are official. In 1891 the wheat harvest amounted to 10,547,168 doppelcentner, which at 22 marks per dc. would have amounted to £11,459,690, but 3,316,059 dc., or £3,595,758, fell to be deducted through depreciation by rust. From the rye harvest had to be deducted £8,896,364. Similarly, from the oat harvest had to be deducted £8,138,023. Hence the loss on a single harvest of wheat, oats, and rye amounted to £20,628,147. In Australia the loss in wheat in 1891 caused by rust was estimated at £2,500,000.

The coffee-leaf disease of Ceylon caused by the fungus *Hemileia* was stated by Professor Marshall Ward to have cost Ceylon over a million pounds per annum for several years. He further states in his book on *Disease in Plants* that one estimate puts the loss in ten years at from £12,000,000 to £15,000,000. He further states that the Hop Aphis is estimated to have cost Kent £2,700,000 in the year 1882. If the recent outbreak of gooseberry mildew of the American type had not been scheduled under the Destructive Insect and Pest Act, and arrested, it would no doubt have wiped out the gooseberry crop throughout the country. Mr. E. S. Salmon states that the average annual value of the gooseberry crop in Kent, Wisbech, Evesham, Calstock, and Gloucestershire is from £97,000 to £160,000 in these districts alone. Also, that the value of the gooseberry crop to cottagers, private gardeners, etc., is incalculable. It was principally through his energy and influence that the disease was scheduled.

At the British Association this year Messrs. Barker and Hillier described a disease known as Cider Sickness, that causes a loss probably amounting to several thousand pounds sterling each year in the West of England alone. It is brought about by a bacterium.

A destructive bacterial disease of the banana and plantain has recently been discovered in the West Indies. The disease causes the leaves to become yellow and drop off.

The terminal bud is eventually killed and the whole plant rots down to the ground. The organism responsible for this has been isolated, and is being provisionally called *Bacterium musæ*.

A disease like this might easily become epidemic and ruin the cultivation of the banana in the West Indies, in the same way as the coffee-leaf disease ruined the coffee industry in Ceylon.

I need not comment further on the loss that would result if plant pathologists were not on the spot, studying and devising means to prevent such a catastrophe.

If we had any means of estimating the loss caused annually by the dry-rot fungus, the figures would no doubt be equally astounding.

We have very little means of estimating cases of annual loss in this country due to disease, but the total must be enormous. Reference to the failure for some years and threatened extinction of the potato crop in Ireland about sixty years ago, with its attendant loss and suffering to millions of people, may recall the seriousness of an epidemic disease of a food plant. Since then preventive means in the shape of spraying have been devised, thanks to the development of applied botany, whereby the disease may be kept sufficiently in check to prevent a repetition of such a dire calamity.

Within recent years an entirely new potato disease was discovered by Schilberskzy in Upper Hungary, namely, the Black Scab disease, which is caused by a fungus, *Chrysophlyctis endobiotica*. In 1901 this disease was found in England by Professor M. C. Potter, and year by year it spread round the originally affected area, and also appeared in more distant localities, till centres of infection were reported from all over the country. In 1908 it was scheduled under the Destructive Insect and Pest Act as a notifiable disease. It is to be hoped that this may be effective in checking its further spread in this country. About two years ago this same disease was discovered by G. H. Gussow in Newfoundland. In connection with the outbreak, Mr. Gussow was sent by the Department of Agriculture of Canada to investigate the origin of the disease, and assist and advise the Newfoundland Govern-

ment in dealing with it. He found the disease to be far more prevalent in Newfoundland than was supposed, and, needless to say, preventive measures have been put in operation by the Canadian Government to prevent the introduction of this disease to Canada. We can only form conjectures as to what would have been the result had this disease appeared forty or fifty years ago. Although it had not actually become epidemic, still we have every reason to suppose that in time it would have become epidemic if preventive measures had not been adopted as the result of timely warning. An epidemic of Black Scab would no doubt be much more severe than was the epidemic caused by *Phytophthora infestans*. The resting spores of the Black Scab fungus are extremely resisting to drought, and may remain capable of causing infection although kept in a very dry state for years. The disease itself is not influenced by varying seasonal conditions, such as wet and dry seasons. Hence, if it had been allowed to get the upper hand, its virulence would have been very severe. Who knows but that the disease may have been imported from this country to Newfoundland, and who knows what other British dependencies may not have been similarly laid open to the risk of infection? In any case, it is essential that all the resources of science should be employed to stamp out any new disease directly it appears.

Owing to the increased and more rapid import and export of plants and plant products (seeds, fruits, tubers, etc.) there is an increased danger of their attendant diseases being spread all over the world. In connection with disease of forest trees, I pointed out in a paper¹ dealing with the liability of the occidental and Japanese larches to be attacked by *Peziza Willkommii* that: "As regards the introduction of exotics which are intended to be grown as timber-producing trees, certain objects must be kept in view. For example, an exotic is worthy of cultivation in our forests—

"Firstly, if it is of a species at present unrepresented and capable of producing timber of utility, or if it possesses

¹ "*Peziza Willkommii*, R.H., on *Larix occidentalis*, Nutt., and *Larix leptolepis*, Gord.," published in "Notes from the Royal Botanic Garden, Edinburgh, No. xxi., August 1909."

advantages as regards rate of growth, and is less exacting as regards soil and climate.

"Secondly, the introduction of an alien species is desirable if it is capable of resisting indigenous diseases, but great care must be exercised so as not to introduce a new disease along with an alien species. An exotic parasitic fungus if introduced may become rampant on indigenous species, and, *vice versa*, an indigenous parasitic fungus is equally liable to attack an exotic host. . . .

"It is therefore quite possible that exotic trees from virgin forests, when introduced into a new country and grown under artificial conditions, may readily become a prey to parasitic fungi, although hitherto in their native habitat they may have been entirely free from disease of any kind."

We are told that in its native habitat the occidental larch is not attacked by *Peziza Willkommii*, and here was an example of an exotic species becoming the prey of an indigenous fungus, or, I should rather say, of a fungus previously introduced from the Continent with the European larch. This country was in other words the common meeting-ground of an American host plant and a fungus disease from the Continent.

As I had already learned from my former teachers in Munich, Professor R. Hartig and von Tubeuf, that such dangers existed, I was glad to be able to add this example as a warning in this country. How little such warnings are sometimes heeded here and elsewhere the following note by Professor von Tubeuf in his Journal, entitled "*Naturwissenschaftliche Zeitschrift für Forst- und Landwirtschaft*," will show. He says: "In an article published in the Year-Book of the German Dendrological Society for the year 1904, p. 156, I drew attention to the danger and frequency of the spread of plant parasites by commerce, not only within a country, but from one country to another, and even to distant parts of the world. I also cited several instances of such occurrences. The transmission of the rust disease of the Weymouth pine within Germany by young infected plants was a typical example.

"The news which now comes from America is still more interesting and significant. This dangerous disease of the

Weymouth pine has been introduced into America, the home of *Pinus strobus*, with a consignment of seedlings sent from Hamburg. In America the disease was unknown and had never been seen there on native trees. Every precaution has been taken to prevent the spread of the disease, and it is hoped that this invasion may be repulsed as a previous appearance of the disease in New York in 1906 was immediately stamped out.

"It is difficult to understand why America imports seedlings of *Pinus strobus* in spite of all European experience and warning, instead of supplying her own wants by seedlings raised from native seeds."

Here is a remarkable example:—An American tree is introduced into Europe, becomes the victim of a European fungus, and in course of time young diseased plants are sent from Europe to America, to the imminent danger of the indigenous trees. The loss to America would have been great if she had not had an organised department to arrest and quarantine these infected plants even at the eleventh hour.

The Weymouth pine is a very desirable tree to grow, not only arboriculturally for ornamental purposes, but also sylviculturally for the sake of its timber. It is called White pine in America, but on this side of the Atlantic its timber is known as Yellow pine, a kind of timber which has become very scarce and expensive of late years, owing to its having been too severely exploited in America. I have seen this tree growing well in the south of England, where it gave every promise of forming an excellent stand of timber in a comparatively short rotation, but I also noticed traces of this disease in its neighbourhood. In Scotland the Weymouth pine grows quite well in suitable places, but the disease is unfortunately rampantly epidemic.

The fungus belongs to the group of metoxenous forms, its alternative host being almost every species of *Ribes*—certainly *R. nigrum*, *R. alpinum*, *R. aureum*, and *R. grossularia*. This fungus is doubly injurious, since it attacks two host plants of economic importance. No effort should therefore be spared to prevent the further spread of this disease or to stamp it out, and such is not beyond the power of properly organised practical mycology.

The remedy recommended is to remove whichever of the host plants is considered to be of the least economic value.

There exist among cultivated plants different varieties, some of them predisposed to disease, others immune. The immunity may be due to anatomical or physiological differences. Whatever the cause of the immunity may be, we can always test whether it exists or not by experimental methods. The fact of great importance is that it is possible to produce varieties which can resist certain diseases, and we are now learning more about the laws which govern the production of varieties, so that the special variety desired can be produced with greater certainty and rapidity than was formerly the case. Our future efforts in stamping out disease *must* be concentrated more on the rearing of resistant varieties than has been the case in the past, and this is another of the ways in which the modern science of Genetics will prove of great value in applied botany.

The remedies for plant disease are mostly all of the nature of antiseptics or fungicides. They are not of the nature of medicines, as generally understood in animal ailments. Still, much may be done by keeping the plant healthy, and supplying it with the right kind and amount of food. Attention to the proper supply of water, heat, and light is also of importance. In other words, keep the plant in a proper hygienic condition, and it will, like the animal under similar conditions, be better able to resist all kinds of disease. In order to do this we must study and understand the inter-relationship between the plant and its surroundings, and it is in this connection that the study of plant ecology from a physiological point of view is of such vital importance.

The method of dealing with outbreaks of disease when they occur locally may be of advantage locally, but individual or isolated action, though of use, is of very little avail in stamping out an existing or preventing a threatened epidemic, because the methods employed are not fundamental: they do not strike at the root of the disease.

In stamping out disease we must have properly organised and combined action, otherwise the best efforts are bound in the long-run to prove futile.

The Americans were among the first to realise the im-

portance of plant disease as a national economic question, on account of the enormous loss which, we have seen, may be caused thereby, and they have a special phytopathological section in their Department of Agriculture, which Department dates from 1889 and has a Cabinet Minister at its head. The aggregate appropriation since 1900 is £18,002,412, and this year the Department has at its disposal about £4,000,000, double of what it was in last decade. The Department employs a staff of 12,480 men and women, 600 to 700 of whom are engaged in scientific research. The money appropriated for the Department in all its branches of activity would amount to £4,514,003. In spite of the magnitude of this sum, it is regarded in America as an investment, and not an expenditure.

An interesting item is the vote of £1000 for the study of the Chestnut Bark disease.

The Chestnut Bark disease is caused by a fungus, *Diaporthe parasitica*, a wound parasite which attacks the main trunk or branches of old and young trees. It first attacked the native American chestnut, but it has spread to the Japanese chestnut and other varieties. This disease was first discovered by Dr. Murrill in New York Botanical Gardens in 1905, and reported on by him in 1906. It spreads with great rapidity.

The chestnut trees of greater New York have all been attacked and practically destroyed. Many valuable trees have been destroyed in all the counties of New Jersey. It has gone through Connecticut westward to the Berkshire Hills, and has spread over Long Island and Staten Island, and has reached far enough west to invade a large area in Pennsylvania. Unless some means is found to arrest the disease, it bids fair to ruin the growth of chestnuts in America, where the timber is highly prized for railway sleepers and posts, mining timber, and farm purposes. In rough construction it is used extensively. Government reports show that the yield in 1907 was 650 million feet B.M., of an estimated value of \$11,000,000. The quantity used for railway ties alone amounts to \$3,000,000 per year. The "Gardener's Chronicle of America" concludes an article on this disease as follows:—"The loss upon which it is most impossible to estimate in dollars is the loss to tree

lovers and tree owners, who would not take any amount of money for the stately forest veterans which have been the pride of their estates. There are large areas of territory not yet reached by the fungus. We may hope that its course may be run, or that study and experiment may evolve an effective remedy before the disease shall cover the remaining chestnut territory."

The expense of the Department may be great; but when the value of the work done and research carried out in the realms of applied botany is set off against it, the expense becomes dwarfed to vanishing point. Surely the American Government is very wisely and well advised in spending a paltry thousand pounds in order that, by study and experiment, an effective remedy may be evolved to save not only the remaining chestnuts but the future crops, whose annual value is reckoned in millions.

Germany has now also a vast and well-equipped organisation for research in connection with plant protection.

At home the practical cultivator of plants may get scientific advice from the Board of Agriculture, apart from which he has to seek his scientific advice from the staffs of our Universities and Agricultural Colleges. Many private societies and even individuals have hitherto done much to disseminate scientific knowledge of great importance to the practical grower of plants. We need only glance at the publications of many different societies to find much information, not only of great scientific interest, but with a direct bearing on questions of practical importance and utility. The Agricultural and Horticultural Press has become a valuable national asset owing to the way in which it has kept abreast of the times, and disseminates a great amount of accurate and valuable information and advice on matters where applied botany can be of assistance to farmers, gardeners, fruit-growers, and all who cultivate the soil.

HOW THE BOTANICAL SOCIETY MIGHT EXTEND ITS RANGE OF USEFULNESS.

In organising their Department of Vegetable Pathology, the Americans found it necessary to have special agents in connection with each institution. These agents are

appointed in as many different localities as possible. One of their principal duties is to instal and supervise experiments of various kinds. Their reports are sent in to the Central Institution, and when the results from a sufficient number of localities seem to justify any conclusion being drawn as to the success of, say, some preventive or remedial measure in connection with a certain disease, then such information is printed in bulletin form and circulated.

In Germany we find much the same kind of organisation. In Bavaria, for example, the Central Institution, namely, the Institute of Agricultural Botany, is situated in Munich, and is under the direction of Dr. Hiltner, who has a staff of highly trained experts in all branches of plant protection. In conjunction with this Central Institution there are a great number of local stations (*Auskunftstellen*) situated in the smaller towns, villages, etc., throughout Bavaria. In charge of these centres are local agents or representatives, not necessarily expert plant pathologists, but nevertheless men of scientific training. Many of these local representatives are clericals, schoolmasters, leading agriculturists, etc. Their principal duty is to send in reports on specially prepared schedules to the Central Institution as nearly as possible every four weeks. Each local station has in turn correspondents (*Vertrauensmänner*) in as many country districts as possible. These correspondents are, so to speak, the men on the spot, and they are constantly in touch with the local agents, and thus the Central Institution is kept constantly informed regarding the state of field and garden crops all over the country, and, should occasion arise, experts can at once be sent to investigate and advise. The Imperial Biological Institution for Agriculture and Forestry situated at Dahlem, near Berlin, is the principal institution, and is kept posted up to date from all the other Central Institutions of the empire.

The ceaseless activity of these institutions has already resulted in the accomplishment of an extraordinary amount of useful work of the highest scientific importance and economic value.

As a Society, we cannot hope to deal with problems in applied botany on the same scale as a well-organised and subsidised State Department; but, nevertheless, we could

be of some use, I think. We have Local Secretaries and members almost all over the country, and no doubt many would be quite willing to make systematic observations on the occurrence, spread, and severity of plant diseases in the forest, field, and garden of their own particular area. Doubtful cases of any disease, the cause of which was not evident to the local representative, might be sent in to headquarters, where a Special Committee might investigate and report. The reports and records of the Local Agents and those of the Central Committee would in time become not only of scientific interest but of great practical utility.

The making and recording of these observations may seem all very simple and such as anyone might be able to make, but I do not propose for one moment that such records should contain a mere list of parasitic fungi found from year to year; such lists alone would have very little scientific or practical value.

These investigations could only be carried out by botanists. They would have to be of the nature of an ecological study of the disease. Such factors as the influence of the soil, the climatic influence, the local method of cultivation, the nature of the attack—slight or severe—the presence of other plants, in fact all the conditions in the physical and organic environment which influence the relationship of host and parasite would be noted and recorded. It is only by such means that we can gain any clear and definite knowledge of the conditions in nature which influence the increase or decrease of disease. It is only when we are in possession of such records that prophylactic measures can be evolved, and plant hygiene placed upon a sound scientific basis.

The complete study of a plant disease may be presented as follows:—First, we should learn to diagnose the disease from its outward visible effect on the plant. This may be called the symptomatology of the disease. Then comes the study of the ætiology, or the investigation of the cause. Then, after the cause is known, we are in a position to find out the cure and future prevention, namely, the therapeutics and prophylaxis. The first and last of these, namely, the diagnosis and prophylaxis, are the most important from the economic standpoint.

Everyone interested in the cultivation of plants should endeavour to make himself familiar with the appearance and effect, and possibly the botanical names, of the commoner disease-causing fungi, also the general preventive measures to be adopted to prevent their spread. It is of the highest importance that a plant disease of any kind should be recognised in its earliest stages, as it is then that its spread may be prevented either by a timely spraying or by the more drastic method of removing the diseased individuals and burning them to make sure the disease-causing fungus is destroyed. It usually happens that before the advice of the plant pathologist is sought, the disease has made itself strikingly apparent by the amount of damage done. It is then often too late to effect a cure.

On broader lines these remarks which apply to the individual apply equally to the State. We have seen how the Governments of other countries have established Departments to watch over the health of cultivated plants, and they are ready at a moment's notice, so to speak, to aid these Departments by special legislation should occasion arise in the shape of a threatened epidemic.

True, our own Government has passed special Acts with the view of preventing epidemics, but, unfortunately, these special laws have been so tardy and so long delayed that their effect on the disease may be the same as the proverbial delay in locking the stable door, and in any case there is not sufficient supervision to ensure that these special laws are carried out so as to be of real value.

From the earliest times we have records that cultivated plants were subject to blights, pestilence, and disease, which the earlier cultivators of the soil attributed to various causes (moon, stars, etc.), but we also find the weather, climate, and soil held responsible for various brands, rusts, and cankers. The existence of parasites or the phenomenon of parasitism among plants was undreamt of. Still, we have here a foreshadowing of the study of the effect of the physical environment on the health of plants. We know now that certain kinds of weather and climatic conditions predispose plants to certain kinds of disease, whose life-histories we know, and we also know that their relationship to their host plants is regulated by external

physical conditions which may render the host plants more vulnerable, and thus enable the parasite to attack and cause disease. The weather as a physical factor may predispose plants to certain organic diseases, so that the observers in these early times were quite correct in their observations, but their conclusions were inaccurate or incomplete.

Bacteriology has mainly owed its development to the work and research carried out in connection with pathogenic forms. The importance of this department of applied botany is too obvious to require more than a passing comment. Although the layman may be accustomed to think of all bacteria as harmful, still the great dependence of the higher forms of plant life on those lower organisms is being made clearer every day. As I have already said, as man becomes more exacting upon the natural resources, so must he in turn endeavour to help Nature by artificial means. As cultivation becomes more intensive, the more must man employ scientific methods to conserve and improve the fertility of the soil, and, in this connection, valuable service has been rendered to agriculture, forestry, and horticulture by the botanist and chemist. The study of plant chemistry and plant physiology has opened up a wide field of research, in which already great progress has been made, many valuable results achieved, and probably nowhere with greater success than in the study of the soil bacteria. The rôle played by the nitrogen-fixing soil bacteria is becoming better understood every day. Successful experiments have been carried out in artificially inoculating the soil with these important organisms. In other words, the soil may be sown with these useful organisms, and upon the success of the development of this invisible soil flora depends the success of crops of higher plants. As we find almost always in Nature, these useful soil organisms have their enemies in other soil micro-organisms, and it has been found that by partially sterilising the soil, crops are improved, the improvement being due to the removal of those organisms inimical to the useful ones. In other words, methods of plant protection may be applied to protect these invisible plants, and thereby improve the quality of the soil and sustain its fertility.

During the last twelve years it is estimated that the agricultural produce of America has amounted to £16,000,000,000. The area of land under cultivation has not increased anything like so rapidly as the value of the agricultural produce; for example, ten years ago the farm products were valued at £800,000,000, now they amount to £1,800,000,000. The increase is attributed entirely to the better and more up-to-date scientific methods generally employed by the farmers, and the change has been brought about by the Agricultural Department.

Recently, on the recommendation of the Development Commissioners, the Treasury has sanctioned the allocation of funds to be administered by the Board of Agriculture in initiating and organising schemes for systematic research in agriculture. The sum to be expended when these schemes are in full working order will be about £50,000 per annum.

Grants will be made for research in various groups of subjects, among which we note plant physiology, plant pathology, and mycology, plant breeding, and fruit growing, including the practical treatment of plant diseases, plant nutrition, and soil problems. A fund not exceeding £3000 per annum will be available for assistance in special investigations, for which provision is not otherwise made.

The Board thoroughly realises the importance of having none but carefully trained men for work in connection with the scheme. The Board therefore proposes to offer for 1911, 1912, and 1913 scholarships of the value of £150 tenable for three years. These scholarships will be twelve in number, and will be awarded only to thoroughly suitable candidates. Grants will also be made to Teaching Institutions, Universities, Agricultural Colleges, etc., in England and Wales. These will act as centres where farmers may apply for scientific advice on important technical questions, and further special investigations of local interest can be carried out by these institutions.

By means of those grants for research scholarships, local advice, and investigations, it is hoped to provide an expert staff with both scientific and practical qualifications, the members of which will be engaged in solving problems of

local importance and endeavouring in every way to secure the application of science to practice.

It is very satisfactory to know that steps are being taken to provide more practical training for the university and college student in order to promote the application of science to practice. But, as I have already indicated, the practical man should have better facilities for acquiring a knowledge of the fundamental scientific principles upon which his practice is based. With one or two notable exceptions, it is not possible for the young gardener or forester in training to attend systematic courses of instruction in the sciences underlying his future profession, unless he happens to be fortunate enough to be employed in some nursery or private garden in or near large towns. This difficulty might be got over by providing bursaries to enable such men to attend courses of instruction at suitable institutions; but to this method there is the very serious objection that very few colleges are able to provide practical training under proper supervision and control along with scientific instruction; however, there are indications that this unsatisfactory state of affairs will soon be improved.

The point is—it is of importance that these practical men should not, when getting theoretical training, lose touch with practice; also, that for the practical work which they perform during theoretical training they should receive payment adequate as a subsistence allowance. A scheme whereby this is achieved is that which has been in operation in the Royal Botanic Garden, Edinburgh, during the past twenty years. Young gardeners and foresters are taken on the staff and receive certain payment for their services, and at the same time are taught free of charge the scientific element of their work. There is no place in this country where more has been done to provide employment, combined with practical and scientific training, for the young gardener and forester, than at the Royal Botanic Garden, and we should feel proud that Edinburgh has led the way in this important development; and experience has shown that the men so trained have had no difficulty in obtaining the best appointments both at home and abroad. With such provision for

the training of the scientist and the practical man in applied science we may look forward to a time when the natural resources will be more carefully conserved and utilised, and the only way whereby this end may be achieved is through sound science to good practice.

REMARKS ON SOME AQUATIC FORMS AND AQUATIC SPECIES OF THE BRITISH FLORA. By ARTHUR BENNETT, A.L.S.

Dr. Glück of Heidelberg is engaged on a study of the aquatic species of the European flora; and Dr. Rothert of Krakau, Austro-Hungary, on a monograph of the genus *Sparganium*.

Both have been this year in England to study our collections, and I had the pleasure of seeing them at my house and talking these matters over with them; these notes are a result, and we trust that our species will be examined.

To Mr. G. West's examination of about 140 Scottish lochs we are indebted for many hints as to the aquatic condition of various species, both of terrestrial, semiaquatic, and aquatic species.¹ In these two papers Mr. West gives the vegetation of these lakes (including in many instances mosses, lichens, and algæ) in their submerged, littoral, and surrounding conditions.

He discusses many subjects, and these papers, it is to be hoped, will be followed up by others, after the manner of Dr. Magnin with the French and Swiss lakes of the Jura,² and the United States in Bull. Michigan Fish Commission, No. 2. "The Plants of Lake St. Clair." A. J. Pieters, 1894.

1. *Ranunculus Flammula*, L., var. *natans* (Pers.).—This is a remarkable form of *Flammula* found by Mr. West in two places, a floating form at the margin of peaty pools about Morton Lochs, Tents Muir. "A strong plant 2 to 3 feet long," and a submerged form in the margins of lochs

¹ 1. "Comp. Study of Dominant Phanerogamic, etc., Flora of Aquatic Habit in three Lake Areas of Scotland," Proc. Roy. Soc. Edin., xxv., 1904-5, with fifty-five plates.

2. "A Further Contribution," as above, Proc. Roy. Soc. Edin., xxx., 1910, with sixty-two plates.

³ "Rech. végét. Lacs du Jura," Revue Gén. de Bot., v. 241, 303.

and slow streams in water 6 to 24 inches deep. Abundant in Lochs Recar, Ballochling, etc. (Kirkcudbright). Persoon describes this as "*γ natans*, fol. inferiorib. ovatis integris, superioribus linearibus," "Syn.," pl. v., ii. (1807), p. 102. Recorded from the same place by Lamarck in "Ency. Meth.," v., vi. (1804), p. 98, but given no name.¹

2. *Ranunculus lingua*, L.—The early submerged leaves of this species, first called attention to by the late Mr. Roper,² are so unlike the flowering stage leaves that unless one had watched the plants it could hardly be believed; they are 8 to 9 inches long by 3 inches wide, and in those I watched were quite decayed when the plant flowered.

3. *Peplis Portula*, L.—Mr. West found an entirely submerged form in Loch Doon (50 to 100 feet deep), Ayr, "growing to a length of 3 feet with larger, thinner, semipellucid leaves, stems weak." This is quite beyond anything I have seen; I have gathered it in Surrey (submerged) 13 inches long only.

4. *Hydrocotyle vulgaris*, L.—Usually a creeping species among higher vegetation in wet or damp places, but in Barlockhart Loch, Wigtownshire, Mr. West gathered a "floating form having stems 30 to 50 inches long, with leaves only $\frac{1}{2}$ inch in diameter and very thin."

5. *Apium inundatum*, H. G. Reichb.—This species varies considerably as to depth of submerged forms. I have seen it in water 2 feet deep. Mr. West records it "in water from 3 feet to 6 feet deep, reaching the surface from even the greatest depth." In Engler's "Bot. Jahrbücher,"³ Dr. Glück throws these various semi-aquatics into groups under three series (p. 104)—

- (1) *Die submerse Flora*,
- (2) *Die Schwimmblattflora*,
- (3) *Die Uferflora*,

placing these species with "*Sium latifolium*, *Ænanthe fistulosa*, *Æ. fluitans*, *Littorella lacustris*, etc."

Mr. West (2) remarks: "In some places, where the water has retreated, the seedlings grow so thick as to cover the

¹ Mr. Ewing's *natans*, "Ann. Scot. Nat. Hist.," p. 237, 1894, seems different from above.

² "Jour. Linn. Soc.," xxi. (1886), p. 380.

³ "Über die Lebensweise der Uferflora," Beibl. 99, 1909, pp. 104–119.

mud with a sward, but their further development in an aerial environment is restrained."

6. *Ceratophyllum demersum*, L.—Not from any submerged point, but as a remarkable instance of distribution, I mention this. In the whole of the Loch Ness area, the island of Lismore, and Nairn; then in Kirkcudbright, Wigtown, Fife, and Kinross (140 lochs), only once did Mr. West collect this species. In Otterston Loch (Fife) "it grows in such extraordinary abundance that in many places a boat can only be rowed through it with difficulty." This I have experienced in Norfolk, where in Blackfleet Broad it was impossible to force the boat through it; it there grew intermingled with *Chara polyacantha* in thick masses.

7. *Juncus supinus*, Moench.—In this we have another species that passes from a strictly terrestrial form through many phases to an extreme one in var. *fluitans*. I have not been able to absolutely trace the submerged form to a terrestrial form, and cultivation is required here, which is just what Dr. Glück is doing at Heidelberg. We seem to possess—

(1) The type as var. *nodosus*, Lange.

(2) var. *pygmaeus*, Maisson.¹ "Caule 1-2 pollicari: anthela depauperata 1-2 cephala."

(3) var. *uliginosus*, Fries.

(4) *Kochii*, Bab.

(5) *subverticillatus* (Wulf.).

(6) *fluitans*, Fries.

What must be a remarkable form is *J. confervaceus*, St. Lager, "Cat. bass. Rhône," 749 (1882)=*f. confervaceus*, Buchenau, in "Fl. N.W. Tiefeb." 136 (1894).

Mr. West has a very interesting note on these forms at p. 976 (No. 1). It is too long to extract, but two remarks may be quoted: "This is one of the most protean species imaginable." "These forms are of extreme interest; in them we seem to be able to trace the phylogenesis of an extremely abundant and dominant aquatic plant; from plastic terrestrial and subaquatic forms; not now dominant nor abundant in this district."

From Rora Moss, Longside, V.C. 93, N. Aberdeen, Dr. Trail has sent me a specimen named var. *comosus*, Bréb.

¹ "Flora Neu-Vorpommern," p. 456, 1869.

"*J. uliginosus* var. *c. comosus*. Capit. nombreux formés de feuell. sélacées en touffe sérieés."¹

Specimen from "pools near the Deveron, Banff, L. Watt sp.," is, I suppose, very near *pygmaeus*, but it is 3 inches high, with setaceous stems and leaves and 2 fl. heads.

It seems now we are to accept "*J. bulbosus*, L., 'Sp. Pl.' 1st ed., 327, 1753; *Juncus foliis linearibus caniculatis, capsulis obtusis*, 'Fl. Suec.', 284," as the name for *supinus*.

8. *Scirpus fluitans*, L.—A remarkable form of this species was found by the Scottish Alpine Club in Lochan Bhe, near Tyndrum (822 feet alt.), 1891. A. H. Evans sp. I have seen nothing so slender as this. I do not know what is the result of growing it at the Edinburgh Botanic Garden, but I think there is no doubt it is a form of *S. fluitans*, though the name has several times been challenged. Notices will be found in the "Edin. Bot. Soc. Trans." for 1891, 1894, 1895, and 1903, p. 318.

We now come to a series of aquatics which Dr. Glück has treated.²

He here treats the plants under their growth and evolution.

9. *Alisma Plantago*, L.—He divides into two varieties—*latifolium*, Kunth, and *lanceolatum*, Schultz; again dividing these into two forms each—*aquaticum*, Glück, and *terrestre*, Glück.

The var. *graminifolius*, Wahlb., he gives as a species *A. graminifolium*, Ehrh., dividing it into four forms: *angustissimum*, Asch. et Graeb.; *typicum*, Beck-Managetta; *terrestre*, Glück; and *pumilum*, Nolte.

10. *A. ranunculoides* he places under *Echinodorus*, dividing it into five forms: *typica*, Glück; *natans*, Glück; *zosterifolius*, Fries; *terrestre*, Glück; and *pumilus*, Glück. He then takes the var. *repens* (Lam.) and divides that into four forms.

No doubt many of these phases of plants may be found among Scottish specimens. I have *A. graminifolium* from Perth, Dr. B. White sp.; and Mr. West found it in Loch Gelly, Fife, as the *f. typica*.

¹ "Brébiasson, "Fl. Normandie" (1869), p. 336.

² In "Allg. Botanische Zeitschrift" for 1906, under "Systematische Gliederung der europäischen Alismaceen."

The var. *zosterifolius*, Fries, in "Bot. Notiser" (1840), p. 35, "foliis longissimis linearibus natantibus (från Öland Sjöstrand) är en markvärdig med *Al. Plantago graminifolium* analog form."

Mr. West gathered this in Loch Corsock in S.E. Kirkcudbright, where "it flowered under water at a depth of 3 feet; without the flower-stalk these submerged forms look extremely like *Isoetes lacustris*." The Rev. E. S. Marshall¹ gathered it from "peat-holes above the Beaully river, E. Inverness, 1892."

Mr. West found the "*f. terrestre* at Loch Leven 1½ inches high."

11. *A. parnassifolia*, Bassi (*Caldesia*, Parlatores) has lately been found in Bavaria,² but I suppose we can hardly expect it in our isles. It has deeply cordate leaves, and only 6 to 9 carpels.

12. *Alisma nutans*, L.—Are there any Scottish specimens of this species in herbaria? I have been unable to see one, but Hooker and Arnott³ give "Black Loch, 6 miles from Stranraer," Wigtown; and in the 2nd ed. of "Topl. Botany," "Ayr, Duncan cat." is added. Mr. Scott-Elliot⁴ does not notice the species at p. 164, though he gives all Wigtown species. That it is often misnamed is certain, as for some years Ireland was credited with it, but it has been found to be a submerged state of *A. ranunculoides*. It is certainly to be found in seven Welsh counties, and in two English (*i.e.* Salop! and Chester!), and perhaps in two others (York and Cumberland). Dr. Glück divides this into *f. typica*, Asch. et Graeb.; *f. sparganifolius*, Fries; *f. repens*, Asch. et Graeb.; and *f. terrestre*, Glück.

13. *Sagittaria sagittifolia*, L.—Glück divides this into *f. typica*, Klinge; *f. nutans*, Klinge; *f. terrestris*, Bolle; and *f. vallisnerifolia*, Coss. et Germain.

Why is *Sagittaria* so rare in Scotland? Two counties only are given, and Messrs. Kidston and Stirling added Stirling. Yet in Scandinavia it occurs from S. Sweden

¹ Cf. "Jour. of Botany" (1893), p. 48; and Bosch., "Prod. Fl. Batavice" (1850), p. 253.

² Glück, "Mitt. Bay. Bot. Ges." (1910), p. 285.

³ "Brit. Flora," 8th ed., 1860, p. 471.

⁴ "Fl. Dumfriesshire," 1896.

(Scania) up to Norland, and is not uncommon in Finland up to 67° 50' N. lat., is absent from Finnish Lapland, but reported from Umba in Russian Lapland, and S. Norway.

Kirchner (*l.c.*) figures a curious form of *Sagittaria*, var. *Bollei*, Asch. et Graeb., which I gathered near Croydon in 1888. In this the three lobes of the leaf are only 4 mm. wide, and the basal lobes at an angle of 45°; the leaf-petioles are more succulent, and show the transverse partitions strongly when dry.

The plate (Tab. 2) that accompanies the classic account of *Sagittaria*,¹ with its details, is quite up to many of the recent drawings of aquatics, and far beyond most. The protecting sheaths of the stolons are in fig. 1 beautifully drawn.

Anyone gathering the var. *vallisnerifolia*, Coss. et Germ.,² might well be excused in not referring it to *Sagittaria*; the leaves are all submerged, linear, varying in length with the depth of water (6 dm. l), and 10 mm. wide. This I have gathered in Surrey, and seen in Norfolk.

A North-American species, *S. heterophylla*, Pursh, has established itself in the River Exe, near Exeter, Devon.³

Sparganium.—Dr. Rothert has found in the late Mr. Beeby's herbarium two specimens of *Sparganium* from Shetland that recede from *S. minimum* and approach *S. hyperboreum*, Laest., "Bih. i. bot. ärsber," 1850. A species of N. Finmark, S. Norway, N. Sweden, Finnish and Russian Lapland, N. Finland, Iceland, Greenland, Labrador, and Hudson's Bay.

S. glomeratum, Laest., *l.c.* (*S. fluitans*, Fr.), is another Scandinavian species that should be sought for; this occurs as far south in Sweden as Scania.

In another work⁴ Glück's ideas are still further worked out, and many figures (Nos. 324 to 379) are given of varying forms, leaf and other sections.

But in neither work are there any attempts to clear up or collate the many other names under these species given in

¹ Nolte, "Bot. Bem. über Stratiotes und Sagittaria," 1825.

² Cossou et Germain, "Fl. En. de Paris," ii. (1845), p. 522.

³ Hiern, "Exch. Club. Rep. for 1908," p. 399, 1909.

⁴ "Lebensgeschichte der Blütenpflanzen Mitteleuropas," by Drs. Kirchner, Löw, and Schröter, 1907.

European floras (mainly under *Alisma*). Neither do Ascherson and Graebner, in their review of these genera, account for many named varieties.

The following experience will show the sequence of a species of aquatic (*Damasonium Alisma*, Mill.) that does not reach Scotland, but which I watched through the summer of 1887 on a common (Mitcham) near here. It had then several ponds, many ditches, and swampy places on a gravelly soil. In one pond (since filled up) the above plant grew pretty abundantly. In April it was the form *graminifolium*, Glück; in May it began to make itself into the form *spathulatum*, Glück; at the end of June it had become the form *natans*, Glück; flowered through July and part of August; at the end of August the water became very low, and the plant here and there became stranded; it was now the form *terrestre*, Glück. The only one I could not say I saw was the form *pumila*, Glück, which he describes as "misera forma terrestris semine nata, etc."

The figure in "Eng. Botany," t. 1615 (3rd ed., t. 1442), shows a state between Glück's *natans* and *terrestris*. In the description no mention is made of any other leaves than the cordate floating ones. The plants noted were simply the growth and evolution of the species, influenced by warmth and depth of water. Certainly in July and August, when gathering this in other parts of Surrey, only the form *natans* could be seen on the water surface; but carefully working in the mud, the form *graminifolius* was found, probably the result of last year's seeding. Syme in "Eng. Botany" queries it as a perennial; Hooker and Babington are silent on this point. Bentham calls it an annual. Grenier and Godron¹ call it perennial, and Ascherson and Graebner² also. My own opinion is that it is neither, but a biennial, as I never was able to find any stolons as in *Hydrocharis* or *Alisma*; and the seeds evidently drop off, sink (they sink at once when ripe!), and in winter or early spring form the little tufts found in July with grass-like leaves.

¹ "Flora France," iii. (1855), p. 167.

² "Syn. Fl. Mitteleurop." i. (1897), p. 389.

ALIEN PLANTS. BY JAMES FRASER.

The following list of plants which I met with during 1911, unless where otherwise indicated, consists of ten new British records (these are marked with a star), several new county records, and plants mainly from localities which indicate a wider and perhaps widening range of distribution for them in counties where they have already been known to exist.

My best thanks are due to Professor Hackel, and to the Director of the Royal Gardens, Kew, for their help in determining several of the more difficult species.

Actæa spicata, L.—In the grounds of Monteviot, Roxburghshire; several.

Matthiola tristis, Br.—Near Musselburgh, Midlothian; several.

* *Silene inaperta*, L.—Near Musselburgh, Midlothian; several.

Lychnis Preslii, Sekera.—Near Tantallon, East Lothian; one clump.

Oxalis corniculata, L.—On the shore of Loch Ryan, nearly a mile north of Sheuchan Mills, Wigtownshire; two or three.

Staphylea pinnata, L.—In the grounds of Prestonhall, Midlothian; several seedlings.

Trifolium Michelianum, Savi.—On reclaimed ground at the Esk mouth, Midlothian; one plant.

Rubus spectabilis, Pursh.—Along the Heriot Water, at Borthwick Hall, Midlothian; very plentiful.

R. odoratus, L.—In the grounds of Prestonhall, Midlothian; several.

Poterium canadense, A. Gray.—On the shore north of Portpatrick, Wigtownshire; several.

Sedum Lydium, Boiss.—By the roadside near Clovenfords, Selkirkshire; plentiful.

* *Crucianella patula*, L.—Near Musselburgh, Midlothian; several.

* *Millotia depauperata*, Stapf, sp. nov.—A plant found on the Tweed shingle at Galafoot in 1908 has been so named by Dr. O. Stapf, Keeper of the Herbarium at the Royal Gardens, Kew, the full description appearing in the *Kew Bulletin*, No. 1, 1910.

* *Centaurea Moschata*, L.—In an old quarry near Slateford, Midlothian; several.

Crupina vulgaris, Cass.—Near Musselburgh, Midlothian; several.

Campanula persicifolia, L.—Near Musselburgh, Midlothian; a large clump.

Nymphoides peltatum, Rendl. and Brit.—In the pond, Prestonhall, Midlothian; plentiful.

Verbascum virgatum, Stokes.—At Murieston, West Lothian, in 1910, and at Leith Docks in 1911; three or four in each.

* *Phalaris truncata*, Guss.—Leith Docks; one plant in 1910. Named by Professor Hackel.

Piptatherum multiflorum, Beauv.—Near Musselburgh, Midlothian; several.

Calamagrostis epigeios, Roth.—Near Portpatrick, Wigtownshire; one clump.

Aira provincialis, Jord.—At Leith Docks in 1905 and 1911; several.

Wangenheimia Lima, Trin.—Near Musselburgh, Midlothian; plentiful.

* *Avellinia Michellii*, Parl.—Near Musselburgh, Midlothian; two plants. Named at Kew.

Desmazeria sicula, Dum.—Near Slateford, Midlothian, in 1907, and at Murieston, West Lothian, in 1910; two or three in each.

Poa Chaixii, Vill.—Near Monteviot, Roxburghshire, in immense quantities; in the grounds of Darnhall, Peeblesshire, in large quantities; in a strip of wood east of North Berwick, East Lothian, scarce.

* *Cutandia incrassata*, Salz.; * *C. divaricata*, Desf.; *Festuca clavata*, Moench (*Vulpia geniculata*, Link), all identified at Kew; and

F. tenuiflora, Schrader (*Nardurus maritimus*, Murb.), named by Professor Hackel; near Musselburgh, Midlothian; several of each.

Bromus rubens, L.—On reclaimed ground at the Esk mouth, Midlothian; several.

B. squarrosus, L., var. *villosus*, Koch; and * *Brachypodium ramosum*, R. and S.—Near Musselburgh, Midlothian; several of each.

CAREX HELVOLA, BLYTT. By ARTHUR BENNETT, A.L.S.

Carex helvola, Blytt, ap. Fries, "Bot. Notiser" (1849), p. 58.

"Spica composita, spiculis subquinis linearibus confertis (disticho-imbricatis), conformibus, distigmatibus, terminali basi mascula; bracteis evaginulatis, membranaceis, brevissimis; squamis ovatis, acutis; fructibus basi cuneata ovatis, glabris, in rostrum compressum subintegrum attenuatis."—"Bot. Not.," *l.c.*; Fries, "Herb. Nor.," fasc. xiii., No. 85, 1849.

C. canescens \times *lagopina*, Kihlman.

C. curta \times *lagopina*.

C. curta \times *Lachenalii*, "Flora Danica," Supp., t. 32, 1853.

In the Transactions of the Society in 1886 I first recorded this as a Scottish plant, gathered by Professor J. H. Balfour in 1846 on Lochnagar.

In 1897 Mr. Druce gathered it on Ben Lawers in Perthshire (14), and published an account of it (15)

In 1906 the Rev. E. S. Marshall (18) gathered it on Lochnagar. "In the great corrie which faces north (above Loch-an-Ean) it grew in wet ground associated with *C. canescens* var. *fullax*. A fine patch of *C. Lachenalii* (*lagopina*) grew within 20 to 30 yards of it, so the hybridity was easy to account for. Alt. 3500 feet. (27/7/1906), in an alpine bog associated with *C. rariflora*, Sm., above the same corrie, in much wetter ground, so that the specimens were on an average considerably more luxuriant. I believe the second station to be identical with Crawford's; E. F. Linton grew his plant, and it remained quite sterile and unchanged. There I could see neither of the parents, but I believe the original station for *lagopina* was very close at hand" (Marshall *in litt.*).

To Mr. Marshall's (R. No. 2980) specimens Herr Kükenthal has added "very characteristic." Good cultivated specimens were issued by Rev. E. F. Linton in 1909, through the Watson Botanical Exchange Club. In 1898 and 1899 Mr. Druce (19) gathered specimens on Ben Lawers that differed, and caused him to write "*helvola*

var." (19). Some of these Herr Kükenthal cites under "*C. canescens* × *stellulata* = *C. biharica*, Simonk."; ¹ others as "*C. tetrastachya*, Traun., ² *supercanescens*, Kükl."

I have specimens gathered on Ben Lawers (19/8/1886) by Messrs. H. and J. Groves which seem to be referable to *helvola*, at that date of course under "*C. curta* v. *alpicola*."

I have seen specimens also from Forfar (Edinb. Herb.), and Mr. N. E. Brown wrote (30/3/1886) that he believed there is a specimen from Ben Muic Dhui in the Kew Herbarium, but had not dissected it; and the late Mr. Beeby wrote: "I seem to have *Curex helvola* from Glas Mheil. leg. Duthie, 1874." This is in Forfar, but on the confines of Forfar, Aberdeen, and Perth, alt. 3502 feet. *C. Lachenalii* (*lagopina*) occurs in Forfar (Ewing). The fullest account we have of the plant is furnished by Herr Kihlman (6), where he also describes a hybrid between *canescens* and *norvegica*, Willd., as *C. pseudo-helvola*.

In Europe *C. helvola* occurs in Finnish and Russian Lapland north to 69° 50' N. lat.; Swedish Lapland; Sweden in Bohuslän, Upland, Södermanland, and Vesterbotten; Norway to 71° 3' (Norman), ³ and distributed from the Birch to the Willow Belts (4); Iceland. Asch. and Graeb., "S. Mitt. E. Fl.," 1902, p. 64. Greenland (5 and 9).

I here confine myself to the original *helvola*, the Tirol, etc., plants being *C. tetrastachya*, Traun.

Neuman (11) strangely puts *helvola* as "*canescens* × *norvegica*," yet has a *canescens* × *lagopina*, and refers to Hartman ⁴ (but he does not give *helvola* as a hybrid, merely saying "habit of the foregoing," i.e. *C. microstachya*, "Ehrh. Hann. Mag.," 1784, p. 9). Dr. Williams (17) gives other hybrids with *canescens* in Europe; of these *C. paniculata* ×, *C. paradoxa* ×, *C. remota* ×, and *C. dioica* × are the only ones that can occur in Britain.

Mr. Fernald ⁵ says his *C. elachycarpa*, figs. 133, 134, "at maturity strongly suggests the little known *C. helvola*, Blytt, which, however, has very different perigynia." But

¹ "Enum. Fl. Trans.," 1886, p. 548.

² Sauter, "Flora," 1850, p. 366.

³ "Not. sumum. concep. Arctic Norway," 1881, p. 500.

⁴ "Skand. Fl.," 11th ed., 1879, p. 471.

⁵ "Proc. Am. Acad. Arts and Sc.," 1902, p. 492.

the figure rather suggests a small or starved *C. curta* than *helvola*.

C. helvola seems to have been first gathered in 1826 by Holmgren (2), and by Blytt in 1833 (2), but not published until 1849.

One difficulty is, *C. lagopinu* is not known on Ben Lawers.

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- (9) ROSENINGE.—Medd. Groenland, Supp., 1892, p. 719.
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- (12) A. BENNETT.—Trans. Bot. Soc. Edin., 1886, p. 361.
- (13) „ Jour. Botany, 1886, p. 149.
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- (15) „ Jour. Linn. Soc., 1898, p. 157.
- (16) „ Jour. Botany, 1898, p. 157.
- (17) WILLIAMS.—Jour. Botany, 1908, p. 369.
- (18) MARSHALL.—Jour. Botany, 1908, p. 108.
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ECOLOGICAL TERMINOLOGY AS APPLIED TO MARINE ALGÆ.

By N. MILLER JOHNSON, B.Sc., F.L.S.

The works of Warming and Borgesen are eloquently suggestive of what research methods *should* be in ecological botany.

That of the former is magnificently comprehensive, covering as it does the whole field, while the latter is no less comprehensive, from, however, a more restricted standpoint.

Algæ are *included* in Warming's work, while they occupy the entire theme of Borgesen's "Faeroese Algæ."

No doubt the general concepts of formation and association possess similar values in the mind of each writer, but

as regards Algæ the terminology clearly shows that the concepts are different.

It would appear that formation as used by Borgesen, implies association as used by Warming.

According to the former, the word formation is used to denote a group of different species belonging, as in the Fucaceæ formation of a sheltered coast, to the same family; whereas, if one correctly interprets the latter, the word formation is used to designate the entire group of Algæ (limno- or halo-nereid formation according to the fresh- or salt-water habitat).

Borgesen's association appears to be a formational unit consisting of one species only, while Warming's association seems to imply a group of plants of one, two, or more species all growing together under the same or similar conditions; or, in his own words, which must be taken to refer to terrestrial vegetation only, "an association is a community of definite floristic composition within a formation" (p. 145).

Thus it will be seen that while under certain circumstances the idea of association as used by both writers is the same, yet in the majority of cases formation, as used by Borgesen, means association as used by Warming, and the association of the former is the plant society of Moss (p. 48, 1910).

The suggestion which the present paper wishes to embody is, that as ecological terminology is now fairly definite, and accepted as such at least in Great Britain, an effort should be made to use the same terms, if not to the entire range of cryptogamic botany, at any rate to marine Algæ.

Just as a terrestrial formation may be divided into two or more sub-formations, the nereid formation (of Algæ) is divided by Warming into two sub-formations:

- (a) Fresh-water (limno-nereid).
- (b) Marine (halo-nereid) (p. 169).

It is customary to distinguish in the latter sub-formation two regions:

- (a) the littoral; (b) the sub-littoral.

These regions could then be again divided into associations and plant societies, according to groups, single species, or in many cases successive storeys, but it will be seen that the sub-littoral habitat would be a great drawback in actual delineation of group boundaries.

Borgesen's methods of nomenclature will be seen from the following (p. 711):—

Of the formations of exposed coasts (littoral region), he recognises among others a *Hildenbrantia* formation consisting of *Hildenbrantia rosea*, *Ralfsia verrucosa*, and blue-green Algæ; a chlorophyceæ formation consisting of *Prasiola crispa*, *Enteromorpha intestinalis*, and *Rhizoclonium riparium*; and a porphyra association found under the chlorophyceæ formation, and consisting of *Porphyra umbilicalis*.

It will be recognised that, according to the preceding matter and suggestions, the terminology would be as under:—

The littoral region of exposed coasts being part of the general halo-nereid sub-formation, consists of, among others, a *Hildenbrantia* association composed of small or large plant societies of *Hildenbrantia rosea*, *Ralfsia verrucosa*, and blue-green Algæ; a chlorophyceæ association consisting of plant societies of *Prasiola crispa*, *Enteromorpha intestinalis*, and *Rhizoclonium riparium*; and, existing beneath the chlorophyceæ association as a lower storey, a plant society of *Porphyra umbilicalis*.

The following summarised notes may illustrate further the suggested method of treatment.

These brief notes are from observations made by the writer on the marine Algæ of the Kirkcaldy district of Fife (littoral region).

Nereid formation of Algæ; marine (halo-nereid) sub-formation; littoral region.

District I.—Ravenscraig to Craig Endle; rocks and sandy beach; creeks and isolated rocks.

ALGÆ.—(1) Fucaceæ association, with *Fucus vesiculosus* (minus bladders) dominant between H. and L.W.M.

(2) Plant societies of—

(a) *Callithamnion scopulorum*.—Extensive, existing beneath *F. vesiculosus* as a lower storey.

(b) *Enteromorpha compressa*.—Not plentiful, on rocks both at H. and L.W.M.

(c) *Porphyra laciniata*.—Fairly plentiful at L.W.M.

District II.—Craig Endle to Dysart harbour; A, a series of creeks; B, a bay with rock areas.

A. (1) Fucaceæ association; *F. vesiculosus* (with bladders where on creek sides) dominant.

(2) Plant societies of—

(a) *F. serratus*.—Common.

(b) *F. spiralis*.—Near H.W.M.; scarce.

(c) *Pelvetia canaliculata*.—In honeycombed rocks near H.W.M.; scarce.

(d) *Enteromorpha compressa*.—Abundant; due to sewage.

(e) *Laminaria digitata*, *L. Saccharina*, and *Chondrus crispus* in tidal pools.

(f) *Ceranium rubrum* (pale brown), and *Enteromorpha compressa* (colourless), in, and due to high stagnant pools.

B. (1) Fucaceæ association; *F. vesiculosus* and *F. serratus* dominant.

(2) Plant societies of—

(a) *Ascophyllum nodosum*.

(b) *Callithamnion scopulorum* and *Gigartina mamillosa*.—Abundant as a lower storey on sea-wall between H.W.M. and half-tide mark.

(c) *Chylocladia articulata* and *Gigartina mamillosa*.—Abundant as lower storey on sea-wall between half-tide mark and L.W.M.

(d) *F. spiralis*.—Near H.W.M.; scarce.

Indubitably supporters of the view that this terminology, as applied to marine Algæ, is capable of improvement, will not be lacking.

The writer, however, ventures (with all due modesty) to suggest that the value of the suggestion lies in the fact that, if acted upon, the study of Algæ from the present standpoint will be brought into unity and conformity with existing methods of phytogeographical terminology.

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ANTHELIA: AN ARCTIC-ALPINE PLANT ASSOCIATION.
By W. G. SMITH, B.Sc., Ph.D.

In the course of the ascent of Ben Lawers by the International Phytogeographical Excursion last August, Professor C. Schröter and Dr. E. Rübel, two experienced Swiss botanists, pointed out a plant association extremely characteristic of the higher Alps. This association presents many points of interest as one in which several Hepaticæ and Mosses play the part of pioneers in colonising a substratum which owes its origin in the first place to topography and in the second place to the action of running water. While the term "arctic-alpine zone" in Scotland is a convenient term for general use, most botanists will appreciate that the zone is by no means uniform in its development. Just as the vegetation of the lowlands presents itself as woods, moors, grassland, and other types, each with sub-types, so in the arctic-alpine zone there are many subdivisions (1) (2). The plant association now under consideration is one of these subdivisions, and it is proposed to bring together here some information which may direct attention to it and may stimulate the study of others.

Last August on Ben Lawers, after ascending the morainic valley of the Tuim Bruic or Carie Burn, and traversing in succession the zones of *Nardus-Juncus squarrosus* grassland and the *Alchemilla alpina* pasture, the lower levels of the south-west corries were reached. Shortly after leaving the clear springs which emerge from the rocks about 3000 feet at the highest limit of a definite stream channel on the Lawers side of the valley, the Swiss botanists drew attention to a long, dark, crusted tract descending from near the base of the "Gentian Cliff," a very conspicuous tract in the rock-strewn green sward of this part. Other examples were seen in ascending the slope towards the low neck between Ben Lawers and B. Ghlas, frequently as dull dark stretches following a series of shallow troughs. Towards the summit the grassy turf becomes more limited, and *Alchemilla alpina* is more and

more restricted to sheltered places beside blocks. Here the most conspicuous plant association is *Rhacomitrium lanuginosum* with *Carex rigida* and other mat-forming plants, but at frequent intervals the darker patches occur. The summit ridge shows many tracts of this black mossy crust, and in the "Cernua Corrie" there is one large patch at the rough wall near the ruins of the Ordnance hut. One has also recollections of other summits where this dark-crust ed humous surface is a feature.

The Swiss botanists recognised these patches and tracts as "Schneetälchen," a term introduced by Oswald Heer in 1836. In L. Schröter's "Taschenflora" (3) the word is translated as "snow-valley," but as English equivalent "snow-gutter" or "snow-flush" more nearly expresses the kind of little runnels suggested by the original term. The vegetation of these snow-flushes has been described by authors like Kerner, Christ, Stebler, and Schröter. The more recent observations of Brockmann-Jerosch (4) indicate that, before dealing with the vegetation, attention should be directed to the topographical and physical factors that bring about its evolution. Anyone who has seen the snow melting on the higher hills can recall the early emergence of rocks or snow-bleached green slopes and knolls. In Switzerland and the Tyrol these are bedecked with flowers while the snow still lies a few yards away. Day by day the snow-patches decrease, becoming more limited to the lower depressions or sunless slopes. The snow-water soaks through the turf seeking the lower depressions till it flows from below the snow and streams away to still lower levels. Thus in troughs and depressions of undulating ground and along the foot of slopes or escarpments there is a system of temporary water-courses which, so long as the snow is melting, are more or less under water. The summer rain-water will tend to follow the same course, but with this difference that the larger supply of ice-cold water is replaced by more occasional trickles of warmer surface-water. On steep slopes these streamlets descend with some force and carve out little stream-beds (snow-water channels), but on gentle slopes or flats or in depressions the force of the flow is not sufficient to erode; the water wanders slowly through the turf and deposits accumulated suspended

matter as a sediment.¹ The snow-water carries the dust which gathers on lying snow, fine particles of mineral matter and fragments of plants, and it also collects other materials as it trickles over the surface. Snow-dust, according to Ratzel, may contain 50 per cent. of organic matter, and as this with the finely divided mineral matter is laid down amongst remains of last year's vegetation, a rich soil is built up. The soil is dark and finely fibrous and when lifted adheres together as clods. On Lawers this turf contains numerous particles of glittering mica, while other samples from Sutherland show particles of gneiss. Brockmann-Jerosch points out that this substratum owes its origin solely to the action of snow-water and rain, and that the snow-flush vegetation occurs where the snow-water collects, not necessarily where the snow-patches lie longest. The substratum results, therefore, from slow sedimentation combined with growth of vegetation which is not swept away but remains perennial, rising gradually each year on the new sediment. This building-up may be seen where a boulder or piece of rock is present and becomes gradually embedded. On these grounds we regard this habitat as migratory and comparable to the flushes described by C. B. Crampton (2); the snow-flush vegetation will, therefore, come under that author's group of migratory plant formations.

During spring the snow-flushes are soaking and their moisture is retained far into the summer, hence in a moist season they remain slimy and slippery underfoot. In a dry summer (as in August 1911) they become cracked and crusted. Although it may be surrounded by a green sward of *Alchemilla alpina* with arctic-alpine grasses (*Festuca*, *Poa*, *Deschampsia*, *Nardus*), the snow-flush is mainly dark in colour except where tufts of *Gnaphalium supinum*, the dark-green mats of *Salix herbacea*, or moss-tufts of *Polytrichum* have become established.

¹ These characteristics suggest the term "snow-flush." The original definition of "flush" by C. B. Crampton (2) is: "Sloping ground gives rise to springs. Where the springs are of small volume, or where they are of a temporary nature flowing only in wet weather, the growth of plants prevents marked erosion of the surface and shallow gutters floored with vegetation result. These may be called 'flushes.' The vegetation and plant association of these flushes depends on the nature and source of the flow of water" (p. 62).

The vegetation of the snow-flush begins with cryptogams, and these frequently remain as the dominant vegetation. The Swiss botanists give the place of pioneer to one of the Hepaticæ, *Anthelia Juratzkana*. This plant lies close to the surface, and in the fresh, moist condition forms a bluish-green carpet. In summer it is often seen in the dry condition as a dark-brown or black mat, which with the lens appears as a tangle of shoots, about 1 mm. thick, closely beset with minute leaves, the whole recalling in miniature a mat of low-growing matted *Calluna*. As pointed out by Professor Schröter, the mat (in August) was dark but with a greyish coating which in his book (5) is ascribed to a thin covering of filaments of fungi. This is also recorded by Heeg (8), who states that the roots are permeated by fungal filaments and may rank as mycorrhiza such as have been described for other Hepaticæ (9).

Specimens taken from a typical snow-flush on Ben Lawers in August last, along with others from similar habitats in Sutherland, supplied by Dr. Crampton, were submitted to Mr. Symers M. Macvicar, who reports that they belong to the genus *Anthelia*, but as the specimens are sterile it is unsafe to say whether the species is *A. Juratzkana*, or *A. julacea*, or a mixture.¹ Mr. Macvicar (10) states that *A. Juratzkana* ascends to the summits of the highest hills in Scotland (4300 feet on Ben Nevis), and that it rarely descends below 1900 feet. In a recent letter he also suggests that the snow-flush association is probably what he has named the *Marsupella* association [(10) p. 7], and he points out that Arnell and Jensen have observed and described the occurrence of *Anthelia* and associated Hepaticæ in Scandinavia. C. Schröter (5) cites a letter in which W. Arnell says that *Anthelia Juratzkana* flourishes best on soils periodically flooded by snow-water, and it also occurs on the banks of streamlets, and more sparingly on bare soil; also that the species becomes more abundant in Scandinavia the higher one goes, and that it is abundant

¹ *Anthelia Juratzkana* (Limpr.), Spruce, in C. Schröter (5); *A. julacea*, Dum., var. *clavuligera*, Nees., in Brockmann-Jerosch (4); *A. Juratzkana* (Limpr.), Trevis (*Jung. nivalis*, Sw.), in S. M. Macvicar (10). *A. julacea* (L.), Dum., is the only other Scottish species.

in Spitzbergen. Rübén (7) follows the Scandinavian botanists in distinguishing an "Anthelietum," which he regards as the basis of the snow-flush types of vegetation to be indicated later. It is thus clear that experienced observers in Northern Europe and the Alps recognise in *A. Juratzkana* one of the pioneers of the snow-flush.

Another cryptogamic element in the snow-flush vegetation is the genus *Polytrichum*, according to the Swiss accounts generally *P. sexangulare*, Flörk., and *P. alpinum*, L., two species recorded as characteristic of the summit region of Scottish mountains. On Ben Lawers we saw cushions of *Polytrichum* (sp. not identified) in the snow-flushes pointed out. This genus of mosses has several species which are adapted for life in moorland flushes, as indicated by C. B. Crampton [(2) p. 62]. They can withstand periodical submergence and soon grow through the shallow deposits of sediment laid down, so that they aid in binding these deposits into a humous turf; the close, compact growth also enables the tufts to withstand periods of drought.

The snow-flush vegetation includes a limited number of flowering plants, but according to Swiss accounts some of these are very characteristic. The following is a list of species recorded in August 1911 (*i.e.* after a dry summer) on the western slopes of Ben Lawers (about 3500 feet) in two snow-flushes where *Anthelia* was a conspicuous element:

<i>Polytrichum.</i>	<i>Gnuphalium supinum.</i>
<i>Racomitrium lanuginosum.</i>	<i>Salix herbacea.</i>
<i>Solorina crocea</i> (orange lichen).	<i>Sibbaldia procumbens.</i>
<i>Carex pilulifera.</i>	<i>Euphrasia</i> (? <i>scotica</i>).
<i>C. rigida.</i>	<i>Festuca ovina</i> (<i>vivipara</i>).

A short list was recorded (August 13, 1898) by Robert Smith on Ben-y-Ghloe at about 3000 feet on patches where snow had recently melted:—*Salix herbacea*, *Gnuphalium supinum*, *Alchemilla alpina*, *Galium saxatile*.

The Swiss "Schneetälchen" is thus described (3):—" *Polytrichum septentrionale* usually appears as a pioneer and covers the ground with a dense, dark-green carpet. Soon afterwards *Arenaria biflora* begins to penetrate this carpet ;

its slender stems and small leaves are half hidden in the moss, so that the stellular flowers seem to be scattered over the carpet as if by accident. Next the creeping, radiating mats of *Cerastium trigynum* associate themselves with these two plants. Later on *Gnaphalium supinum* steps on the scene, or the long red creeping shoots of the five-leaved lady's mantle (*Alchemilla pentaphyllea*) become interlaced, so as to form connected masses."

Brockmann-Jerosch (4) gives the results of examinations of nineteen examples of snow-flushes, recording the number of times each species was noted. Rübel (7) also gives results from forty-eight stations. Both authors worked in the Rhætian Alps, an extensive area of high altitude. The following table gives—for Scottish species only—the number of times of occurrence recorded from the above two memoirs:—

	Rübel.	Brockmann.
<i>Gnaphalium supinum</i>	44	15
<i>Salix herbacea</i>	43	16
<i>Polytrichum</i> , spec. div.	31	frequent
<i>Poa alpina</i>	27	5
<i>Taraxacum officinale</i> (alpinum)	25	9
<i>Veronica alpina</i>	20	7
<i>Alchemilla pentaphyllea</i>	16	8
<i>Anthelin Juratzkana</i>	15	frequent
<i>Sibbaldia procumbens</i>	14	7
<i>Cerastium cerastioides</i>	13	11
<i>Carex Lachenalii</i>	9	...
<i>Polygonum viviparum</i>	8	...
<i>Euphrasia minima</i>	5	...
<i>Deschampsia cespitosa</i> . . . . .	...	7

The species recorded for snow-flushes by Oettli (6) for the Churfurst and Sentis areas are also included in the above table.

These lists are characteristic for stations on crystalline rocks. The catalogue from calcareous rocks is much longer, with few Scottish species, and has *Salix retusa* as a characteristic plant. The Scottish lists, taken along with other notes, suggest that the same association is represented as on the crystalline rocks of Switzerland. It is probable that in Scotland *Cerastium cerastioides* and *Veronica*

alpina also occur on snow-flushes, while *Poa alpina*, *Deschampsia cæspitosa* (arctic-alpine form), and *Polygonum viviparum* are widely distributed over other arctic-alpine associations.

The various authors point out that the conspicuous flowering species of the snow-flush vary from place to place. Here *Polytrichum* may form a carpet, there *Salix herbacea* a mat, or *Gnaphalium* in white tufts. Rübél gives prominence as tone-imparting species to *Polytrichum*, *Salix herbacea*, *Sibbaldia*, *Alchemilla*, *Gnaphalium*, and *Ligusticum Mutellina*, and he demonstrates that the association presents sub-types according to the dominant plant; thus *Arenaria biflora* is given as much more abundant when *Polytrichum* is the conspicuous plant; on the other hand, *Gnaphalium* is fairly constant in all the sub-types of snow-flush. This patchy occurrence of various plants in separate stations or within the same snow-flush leads Brockmann to the conclusion that accident or chance plays an important part in the constitution of the plant-covering. In other words, the snow-flush is an open association into which species from neighbouring plant communities migrate. The existence of comparatively large pure patches of a single species, frequently observed in the snow-flush, is attributed to the capacity of the plants for vegetative propagation. It seems to be essential for existence in the snow-flush habitat that the species should form low matted tufts sufficiently compact to resist periodic flooding, and along with this the power to extend laterally by short horizontal shoots. *Gnaphalium supinum* forms mats from which the short flowering stems arise, and short horizontal shoots extend along the ground to give off new leafy shoots which flower in some future year. *Cerastium*, *Sibbaldia*, *Alchemilla*, and *Veronica alpina* extend by lateral branches rooting in the underlying carpet of *Hepaticæ* or Moss. *Salix herbacea* forms a loose mat extending comparatively rapidly by underground horizontal branches which root and may form new plants. That this habit of growth leads to considerable stability may be experienced when one collects specimens; either one brings away much soil attached, or the shoots break off short, leaving most of the plant behind.

Another interesting adaptation is noted by Brockmann-Jerosch, namely, the presence of a felted coating of hairs which entangles air when the plant becomes submerged by occasional water, and so prevents flooding of the leaf. He recalls the silky white sheen on such leaves as *Gnaphalium*, *Cerastium*, *Sibbaldia*, and *Alchemilla alpina* when seen under a shallow layer of flood-water.

The evolution of the snow-flush vegetation is indicated in E. Rübel's account. *Anthelia*, perhaps preceded by still lower organisms,¹ forms a humous tuft, fairly stable and liable to invasion by other species. *Polytrichum* follows later, and more or less takes the place of *Anthelia*. Later still *Salix herbacea* or *Alchemilla* assumes chief place. Rübel has observed where the different sub-types occur beside each other that *Salix* takes the higher and drier situations, which in Switzerland adjoin the extensive plant association of *Carex curvula*. Each of the stages of vegetation probably indicate stages in the evolution of the habitat, since the later vegetation will tend to give it increased stability. In time the accumulation of sediment, humus, and vegetation may be such that the snow-water is diverted to new situations, where the sequence will begin over again. During the various phases other species secure a footing and flourish well or ill according as the habitat suits them. Rubel suggests that *Taraxacum* and *Cerastium cerastioides* find in the snow-flush that abundance of organic matter which they require; in Switzerland both are characteristic species of the "lair-flora," that is, places manured by sheep, goats, or other animals, where grasses like *Poa annua* flourish. Again, *Carex Lachenallii* he has observed invading the snow-flush from neighbouring marshes. All these observations point in one direction: that the snow-flush is a series of migratory associations. These were recently defined by C. B. Crampton (11) (p. 8): "Migratory formations are of comparatively short persistence on the same habitat, which sooner or later undergoes change or destruction, with renewal elsewhere. Their associations tend to rapid degeneration from plant invasion. All stages of pro-

¹ Mr. Macvicar (*in litt.*) informs me that *Anthelia* is preceded by an alga.

gressive successions of associations are encountered." It seems to us that along these lines the somewhat complex distribution of our arctic-alpine vegetation must be studied.

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MOSSES FROM THE WESTERN HIGHLANDS.—By JAMES STIRTON, M.D., F.L.S.

Leucobryum pumilum (Michx.) has been found at last near Gairloch, Ross-shire, on the 20th of September 1911. Bryologists have searched during a long course of years for this moss throughout Europe and Great Britain, but until lately quite in vain. I have a distinct recollection of hearing Professor Schimper of Strasbourg, author of the "Bry. Eur.," while on a visit to this country in 1865, urge those interested in mosses to institute an organised search for a *Leucobryum* having leaves with deeply cucullate apices. Several in Glasgow directed their attention for twenty years thereafter towards the discovery of such a moss, but without success. In 1882 a Mr. Piffard discovered, in the New Forest, England, *L. minus* (Hampe), then reckoned a variety of the common *L. glaucum* (L.), but now named *L. albidum* (Lindeb.), for what reason I know not.

At this stage the search gradually abated for nearly thirty years longer until, in 1911, *L. pumilum* (Michx.), the moss to which attention had been drawn fifty years previously by Professor Schimper, was found near Gairloch, growing on the *debris* of the Torridon Rock.

I have carefully compared genuine specimens of this moss from Dr. Braithwaite, who got them from Mrs. Britton, keeper of the Moss Herbarium in Bronx Park, New York, and the Scottish and American specimens agree in every particular.

Whilst working amongst the Torridon Rock what struck me as very peculiar is the fact that, in spite of its hardness, it is easily disintegrated by the rootlets of slender mosses. Many such, chiefly species of the genus *Grimmia*, are found growing on large exposed masses of this rock and mostly in saucer-like depressions. On detaching these tufts they appear as if they had been reared in loose sand, whilst a corresponding cavity in the rock is revealed. I may return to this subject on another occasion. Another peculiarity presented is the deep dark-green colour assumed by mosses growing on it, while the same mosses growing on other rocks usually exhibit a greyish appearance more or less deep. That this prevailing deep green is not of the same constitution throughout may be inferred from the fact, that in some instances it changes, in the course of two or three weeks, to a deep coppery hue throughout the entire plant, in others it slowly turns to a dingy yellowish-green, while in the majority of cases the colour remains nearly unchanged for many months.

An instance of the first of these changes in colour is the following which, besides, is remarkable otherwise, owing to the peculiar shape of a proportion of the upper cells of the leaf, viz. barrel-shaped, with lateral walls, convex and rugose, while the ends are usually narrowed and nearly straight.

Grimmia rubescens, sp. nov.—In small, dense, convex tufts of a dark green above, rapidly changing throughout to a dark copper colour, quite unlike the dingy grey usually assumed by others of the same genus; stems about an inch long or less, simple or dichotomously divided, much less frequently fastigiately branched; leaves closely arranged

around stem, spreading slightly and straight when moistened, narrowly ovate lanceolate, ending in a broad apex, latit. $\cdot 07$ – $\cdot 1$ mm., surmounted by a broadish hyaline hair tapering to a point, sparsely spinulose, variable, from a third to nearly as long as the leaf proper; nerve narrow below ($\cdot 04$ mm.), widening somewhat upwards, then narrowing to summit, pale then copper-coloured; margin entire, recurved in lower half, plane afterwards, the other margin quite plane throughout, the upper half thickened by two couples of transverse cells and towards apex interruptedly bistratose throughout; cells in four to six short rows at inner base narrow, cylindrical, separate (especially laterally), $\cdot 04$ – $\cdot 07$ by $\cdot 004$ – $\cdot 6$ mm., slightly granular, ultimately pellucid, outwards becoming (rather abruptly) nearly elliptical, dark, opaque, and granular outwards to recurved margin; on the plane margin two to five short rows *hyaline*, sharply oblong, close, $\cdot 013$ – $\cdot 02$ by $\cdot 007$ – $\cdot 9$ mm., up from base cells very irregular in size and shape, barrel-shaped or only irregular in outline, and slightly narrower than those at base but of the same length. or cells merely round but more of such nearer apex and nerve; only four capsules in a young state were found; seta pale, short, straight or slightly bent, about a third of an inch long; capsule elliptical, rugose; lid and teeth red, short, pointed; acumen short, blunt, red, not more than a fourth the length of capsule.

There is another moss rather closely allied to the preceding, but as it presents one strange peculiarity such as I cannot recall having ever seen previously, I consider it right to describe it here.

Grimmia undulata, sp. nov.—In rather dense convex tufts of a dark-green colour above, becoming darker in the herbarium, ultimately assuming a dingy brown in the lower half; stems slender, about an inch long, simple or slightly branched; leaves laxly arranged around stem, nearly appressed, with the longer hairs everted; when moistened spreading somewhat, straight and slightly undulating, remaining attached to the stem nearly to base, long, slender, ovate lanceolate, acuminate, terminating in a slender hair very variable in length, from a mere point below to about half the length of leaf above, slightly spinulose; cells at

central base long, cylindrical, close, often attached, '06-.09 by '006-.9 mm., slightly granular, ultimately hyaline, outwards shorter, bluntly oblong, with two to four short rows of cells next margin smaller still, sharply oblong, '016 by '006 mm., but all basal cells becoming hyaline; upwards cells become gradually shorter and merge nearly transversely into the upper dense, opaque, chlorophyllose, round or roundly quadrate cells, length variable from '009 to '016 mm. in longer diameter, in upper third somewhat smaller, '007-.9 mm.; nerve soon turning brown, firm, solid, breadth near base '05-.065 mm., a little broader upwards then lessening to acute apex, of dense structure within; the posterior wall shows a single row of chlorophyllose cells as in the pagina, but nearer the front a row of three largish pellucid cells; margin of leaf recurved a little more than the lower half, entire; a thin transverse section of leaf shows the margins thickened in a remarkable manner, by a round cluster of cells grouped together without order, in number from seven to fifteen so as to form a thick round club three times the thickness of the rest of pagina; this thickening is often seen a little below the middle of leaf but smaller. Barren. On the red rock in several places near Gairloch. This moss is rather closely allied to *Gr. trichophylla* (Grev.).

Another interesting moss deserves to be recorded, viz. a *Bryum*, so closely resembling in size and appearance the greenish forms of *B. argenteum* that I passed it on more than one occasion without inspection.

Bryum elegantulum, sp. nov.—Tufts very dense, slightly convex, green above, pale but tending towards a reddish tint below; stems very slender, about half an inch or less in height, simple or sparsely divided, red and red-radiculose in lower half, to which also minute acutish leaves are attached; upper leaves rather suddenly enlarged, but still minute, scarcely a millimetre in length, closely arranged and even imbricated so as to form, at and near apex, a rather elongated comal group, such upper leaves are oblongo-ovate, concave, narrowing convexly above to a point, from which arises a long, slender acumen about one-third the length of leaf proper, or from '2 to '35 mm. long, terminating acutely and having the same construction as the rest of the pagina, but the cells composing it a little longer; nerve slender and thin, breadth near base

about .03 mm., tapering and ending in the acumen; margin plane, entire, having two rows of cells less than half the breadth of those of the rest of the pagina but longer; cells at base in two to four transverse rows (across base), oblong or quadrate, with thickish, opaque walls, .025-.032 by .012-.022 mm., those above for the rest of leaf acutely rhomboid, large, close, .04-.06 by .014-.02 mm. Leaves almost destitute of chlorophyll.

This moss is certainly distinct from *B. argenteum* in the narrow border-cells of the leaf, in the nerve which reaches the apex and, from the character of the cells in the lower part of the acumen, probably extends a little into it, as well as from the length and constitution of the acumen itself, which, in *B. argenteum*, is only represented by a bluntish knob; lastly, from the differences in the shapes of the leaves, as well as from differences in the paginal cells in the two mosses.

In woods in Lovedale, near Gairloch. Only one long, strong seta was observed in a tuft, but as it dropped off I could not find anything on it.

At Onich, on Loch Linnhe, a tuft of *Plagiothecium Mülleri* was picked up in fine fruit. The station is unusual, not many feet above sea-level. This is the only specimen which has been found in fruit in Great Britain.

In 1909 at Onich, on Loch Linnhe, a moss was discovered to which a proper place could not be assigned, but as the same moss was secured in 1911 at Gairloch, I feel constrained to give an outline of its main characteristics.

Barbula incarvata, sp. nov.—Tufts large, very dense, green above, changing in the herbarium to a dingy yellowish green, brown below; stems simple or slightly branching, slender, about half an inch long; leaves incurved when dry, spreading a little and straight when moist, *hollow* throughout, elliptical or narrowly so, length 1.5 mm. by .35 mm. in breadth near middle, blunt and round at apex; margin plane, slightly incurved towards the summit, faintly crenulated or nearly entire; nerve strong, pale, then fulvous, vanishing a little below apex; cells at inner base oblong or somewhat rhomboid, detached, ultimately pellucid, variable, .022-.04 by .008-.011 mm., outwards smaller, thinner, ultimately hyaline, latit. .006-.008 mm. across, upwards

changing transversely into others, very peculiar, giving at first the impression that they are very minute, viz. .004-7 mm. across, but such are ultimately seen to be the dimensions of particles of chlorophyll, whereas the cells proper are bluntly quadrate, close, with very thin transparent walls, containing four particles of chlorophyll in each, and .009-.014 mm. across, ultimately dark and opaque; such are found throughout the rest of the leaf, the larger next the nerve. Leaves are minutely papillose, more especially in their upper third, less frequently on the margin; height about .0025 mm.

At Onich near seashore in two places; in one place similarly situated at Gairloch, 1911.

SCOTTISH FORMS OF SPARGANIUM. By ARTHUR
BENNETT, A.L.S.

Following up my previous notes (see p. 26), I here give the forms of this genus, which I have from Scotland.

The specimens have all been seen by the late Mr. Beeby and by Dr. Rothert.

The names are given in the sense and value of the describers, although opinions may differ as to their being varieties, states, etc.

Sparganium ramosum, Curtis (*sensu* Beeby).¹

f. microcarpum, Neuman in Hartm., "Sk. Fl.," 112, 1899.²
—Crianlarich, Perth, E. S. Marshall sp., 1893. Dalmally, Argyll, E. S. Marshall sp., 1893. Baldernock, Stirling, R. McKay sp., 1887.

S. affine, Schniz.

a zosterifolium, Neuman (*l.c.*)—Unst, Shetland, W. H. Beeby sp., 1887.

β deminutum, Neuman (*l.c.*)—Loch na Criche, Moidart, v.c. 97, S. Macvicar sp., 1895.

γ microcephalum, Neuman (*l.c.*)—Loch between Rackwick and Orgill, Hoy, Orkney, E. S. Marshall sp.

S. minimum, Fries, var. *flaccidum* (Meinh. sp.).—"Mél. Biol.," xviii., 3, 393, 1893. Isle of Gigha, v.c. 101,

¹ *S. erectum* (a), Linn, "Sp. Pl.," ed. 1, 1753, 971.

² First part, all published.

A. Somerville sp. Colonsay, v.c. 102, M. McNeill sp. var. *rostratu* (Larsson sp.), "Fl. Vermland och Dal," ed. 1, 1859. Islay, v.c. 102, A. Somerville sp.

The var. *microcarpum* of *ramosum* is the one most nearly approaching in habit, etc., to *S. neglectum*, Beeby.

The only Scottish specimens seen of *S. neglectum*, Beeby, are from the Isle of Lismore, v.c. 98, S. Macvicar.¹

Mr. Beeby remarked on these specimens:—"From a careful examination of your *Spargania*, they certainly appear to me to be *S. neglectum*. But hitherto the northern limit has been v.c. 62, N.E. York; while on the west side there is nothing north of Cheshire!. Hence I should have been glad to have seen a ripe fruit. The extension of range is remarkable; however, it occurs in Denmark (v. sp.), in almost the same latitude as Berwick, c. 55° 50', while Lismore is c. 56° 30'. There are records for the mainland of Sweden on good authority up to about 50° 10'. Another at 59° will decidedly require confirmation. I cannot do other than name your plant *S. neglectum*." — Beeby, 8/10/1898.

Contrasting these against Mr. Burkill's from Scarborough, York (1896), the fruit is decidedly smaller, and the Scarborough specimens would perhaps come nearer to the var. *oocarpum*, Celak, in "Oest. Bot. Zeit.," 425, 1896.

S. affine zosterifolium is taken as the type by Neuman; whether this is so with reference to Schnizlein's specimens I am unable to say, as I have not seen a type specimen.

Ascherson and Graebner² under *affine* cite "*S. alpinum*, Don ex G. Don, in 'Loud. Hort. Brit.,' 375, 1830, name only." But in Headrick's "Survey of Forfar" (1813) Don uses the name *S. natans*³ as found in the Lake of Forfar.

So far as I have seen there seems to be little variation in the other species, i.e. *S. simplex*, Huds., in Scotland.

The following are additional records to "Topl. Botany" and Supplement:—

S. ramosum (Ebudes), 102, "S. Ann.," 1906.

S. neglectum, 74, Wigton, "Ann. Scot. Nat. Hist.," 101, 1910.

¹ "Ann. Scot. Nat. Hist.," p. 39, 1899.

² "Sy. Fl. Mitt. Europe."

³ "Notes, Roy. Bot. Garden, Edin.," No. xiv., p. 215, 1905.

S. neglectum, 78, Peebles, "Ann. Scot. Nat. Hist.," 101, 1910.

S. affine, 85, Fife, G. West.

S. affine, 109, Caithness, Dr. Davidson sp.

Since Mr. Beeby's remarks, *S. neglectum* has been found in West Lancashire by Messrs. Salmon, Thompson, and Wheldon.

NEW OR IMPERFECTLY DESCRIBED SPECIES OF ACACIA
FROM WESTERN AUSTRALIA. By ALEX. MORRISON.

Acacia densiflora, n. sp. — Phyllodia subulate, terete, striate; flowers in globular sessile heads, 5-merous, with a short turbinate-lobed calyx.

A rigid shrub with terete, closely woolly-pubescent branches, phyllodia subulate, somewhat spreading, terete but slightly flattened, rigid, mucronate but scarcely pungent, slightly narrowed at base, with 15-20 rather prominent striæ and minutely pubescent, 0·8-2·5 cm. long and about 1 mm. thick.

Inflorescence in globular sessile flower-heads crowded in pairs in the upper axils; flowers about 20 or fewer in the head, 5-merous, calyx turbinate with short lobes, woolly, less than half as long as the petals, which are subacute, smooth, with the midrib somewhat prominent near the top. Pod not seen. (Kellerberrin, E. Avon district. R. B. Leake.)

Meissner describes a barren specimen from the interior (Preiss. No. 976, "Pl. Preiss," i. 12) as a possible variety of *A. leptoneura*, but Bentham in "Fl. Austral" has placed this under *A. aciphylla*, without, however, having seen Preiss's specimen. Our plant, if it should be the same as that collected by Preiss, differs in aspect from *A. aciphylla*, being a scrubby, rigid shrub, with the flower-heads distinctly globular, so that Meissner seems to have been nearly right in placing it under *A. leptoneura*. Moreover, although the calyx is that of *A. aciphylla*, the globular flower-heads and the phyllodia approach those of *A. leptoneura*, so that this plant may be set down as a distinct species.

Acacia longispinea, n. sp.—Phyllodia linear tetragonous, rigid, mucronate; inflorescence in pedunculate globular heads containing numerous 5-merous flowers, with free sepals and petals; pod flat, straight, seeds ovate attached by a short funicle without folds or aril.

A glabrous shrub with terete branches, the phyllodia being incurved, with very prominent ribs as in *A. gonophylla*, narrowed at the base, and tapering to a short point, 5-12.5 cm. long by about 1.5 mm. broad, stipules minute, deciduous. Peduncles in pairs in axils, slender, spreading or reflexed, 0.7 cm. to 2.2 cm. long, bearing heads of about 6 mm. diameter, containing 40 or 50 florets. Sepals very narrow linear spathulate, ciliate, $\frac{3}{4}$ as long as petals, which are distinct, tapering below, and smooth. Pod stipitate, linear-oblong, straight, slightly contracted and depressed between seeds, flat, 2.5-5 cm. long by 0.5 cm. broad, valves coriaceous with margins thickened. Seeds longitudinal but sometimes slightly oblique, ovate, flattened, mottled, 0.25 cm. long; funicle short and slender, dilated at base, but scarcely thickened or folded, about half as long as seed. (Kununoppin, E. Avon district. F. E. Victor.)

F. v. M. and Tate, in their report on the plants of the Elder Expedition, p. 351, note "*Acacia* (aff.) *gonophylla*, Benth., with long phyllodes. W. A. near Barrow Range," and probably this is the same species. As compared with *A. gonophylla*, Benth., besides having longer phyllodia, the peduncles are longer, the flower-heads larger and containing numerous florets, the ladle-like sepals with a very slender claw and broad orbicular lamina, and about $\frac{3}{4}$ as long as the petals; the pod is depressed between the seeds but not contracted on the margins; the seeds are ovate and flattened, and the funicle is different.

Acacia uncinella, Benth.—As the fruit of this species is imperfectly known, the following description may be given:—

Pod (not quite mature) almost sessile, linear, straight, flat, with thickened sutures, slightly contracted between the seeds, obtuse and more or less beaked at the top, maximum length 5.6 cm. by about 0.2 cm. in breadth. Seeds longitudinal, oblong, funicle thickened and shortly folded

under the seed and forming a white and membranous cup-shaped aril. (Kununoppin. F. E. Victor.)

Acacia triquetra, Benth.—This species differs from *A. Meissneri* in the nerve-like margins of the phyllodia, longer peduncles, pod (immature) curved and narrow, not over $1\frac{1}{2}$ lines broad, and funicle short with a large aril.

Bentham separated *A. Meissneri*, Lehm., and its var. *angustifolia*, as described by Meissner ("Pl. Preiss," i. 13) under the one specific name, making the variety a distinct species, namely, *A. triquetra*. With the exception of the linear phyllodia, our plant answers to the description of this species, but its phyllodia have the obliquely obovate form of those of *A. Meissneri*, with the upper margin more arched than the lower, and bearing a gland below its middle, though differing in having nerve-like margins. The chief distinction between the two species, however, is found in the pod, which in the Kununoppin specimen is nearly sessile, much curved and twisted, forming sometimes more than two circles, somewhat turgid and narrower between the seeds, which are longitudinal, oblong, with the funicle very short and bearing a very large yellowish aril broader than the seed. (Kununoppin. F. E. Victor.)

Acacia pyrifolia, DC., n. var.—At the Ashburton river two forms of *A. pyrifolia*, DC., were met with; one, which appears to be the usual form, growing as a small tree on the open plain, where a heavy clay soil is sometimes seen forming a bare surface but is usually covered with sand. Its phyllodia are thick, undulate, rigid, and primose, and the inflorescence is of a very dark purplish colour. The other grew near the river, as a shrub, amongst others, and somewhat protected from the severity of the heat. In form the phyllodia were exactly the same, but this grew with more prominent veins, while the pods were of a paler colour. The funicle of the seed, however, is much shorter, not passing completely round the seed, while in the other form it makes a complete revolution before being folded twice and somewhat thickened to form an aril.

Acacia microbotrya, Benth.—As Bentham had doubts about the fruit of this species, the following may be added to his notes on the subject:—Pod (not yet mature) on a stalk of about 0.6 cm., straight, flat, valves coriaceous with

thickened sutures, finely reticulate over the seeds and much contracted between them, seeds convex alternately on either surface of the pod, which is found to reach 15 cm. in length and about 0·7 cm. in breadth over the seeds. Seeds sometimes as many as ten in the pod, longitudinal, oblong, flat, 5 mm. in length; funicle long and slender, two or three times folded and expanded below the seed into a large club-shaped fleshy aril. (Hannan's Lake, Boulder. W. D. Campbell.)

Acacia Lindleyi, Meissn.—Meissner, describing *A. Lindleyi* as a new species, speaks of it as being distinct from all others, but he cannot have seen *A. subcærulea*, published by Lindley in the "Botanical Register" in 1827, for the description of the latter applies remarkably well to the former, as seen in specimens from Coolgardie and Kellerberrin districts. To this similarity may also be ascribed the origin of E. Pritzels *A. subcærulea*, Lindl., var. *subsessilis* ("Bot. Jahrb.," xxxv. p. 303). Spencer Moore also records *A. subcærulea* from near Coolgardie, but in the "Fl. Australiensis" the only localities given for this species are on the south coast. The only ready distinction is found in the longer racemose and more slender branches of the *A. subcærulea*.

The fruit of *A. Lindleyi*, however—up to the present unknown—is very different from that of *A. subcærulea*. The pod measures up to 7·5 cm. in length by 0·6 cm. in breadth, it is stipitate, flat, obtuse, and is coiled more or less into circles; the valves are coriaceous, with the sutures somewhat thickened, depressed between the seeds, and showing transverse veins reticulating on their surface. The seeds are longitudinal, ovate, smooth, black, with a short and slender funicle, not thickened nor folded, about half the length of the seed. (Kununoppin. F. E. Victor.)

Acacia dictyophleba, F. v. M. "Pod unknown," Ben-
tham, "Fl. Aus.," ii. 388.—Pod very shortly stalked, flat but undulating over the seeds, resinous and glistening, oblong, rounded at both ends, valves coriaceous, margins straight and nerve-like, with numerous transverse veins reticulating over the surface, maximum dimensions 5·5 cm. long, 1·4 cm. broad. Seeds transverse, oblong, 0·5 cm.—0·3 cm., blackish brown; funicle flattened, thrown into

numerous short folds, forming a large pale yellow aril under the seed. (Uaroo, Ashburton River, N.W.)

Acacia aciphylla, Benth.—As the pod has been only imperfectly described, a few notes are here given:—Pod shortly stipitate, linear, terete, slightly contracted between the seeds, with an obtuse more or less hooked apex, max. length 5.6 cm. by 0.15 cm. broad. Seeds longitudinal, linear-oblong, brown; funicle slender, thickened and repeatedly folded below seed, and forming a white cup-shaped membranous aril embracing its base. (Kununoppin. F. E. Victor.)

Acacia ephedroides, Benth.—Pod on a stalk of 3-4 mm., linear, flat, obtuse or bluntly hooked at top, length 6.5 cm., breadth over seeds 0.25 cm., valves coriaceous, thickened along margins, contracted between seeds, light brown, veined on surface. Seeds longitudinal, narrow-ovate, 3 mm. in length, smooth, brown, funicle forming a number of large folds and expanding into a large white membranous aril below the seed. (Kununoppin. F. E. Victor.)

Acacia stereophylla, Meissn.—This specimen agrees perfectly with the description of *A. stereophylla* as given by Bentham ("Fl. Aus.," ii. 404) as well as by Meissner himself ("Pl. Preiss.," ii. 203), but as its fruit does not appear to have been hitherto met with, a description of the pod is here given.

Pod shortly stipitate: flat, straight, oblong-linear, bluntly mucronate, obscurely reticulate, valves chartaceous, light brown, slightly thickened along margins, 1-2.5 cm. in length by 0.3-0.4 cm. broad. Seeds longitudinal, ovate, turgid, brown, smooth and shining, at most 0.25 cm. by 0.15 cm.; funicle very slender in lower half, but folded and thickened above, forming a large membranous aril, as in *A. acuminata*. (Kununoppin. F. E. Victor.)

E. Pritzel has come to the conclusion that *A. cibaria*, F. v. M., is really the plant known as *A. stereophylla*, but this decision is evidently not based on an examination of the original or any other specimens of *A. stereophylla*, but on the published description only. *A. cibaria* (the description of which is not available here) is believed to have all the characters of *A. stereophylla* as described, and therefore is the same species. Pritzel, however, describes

the fruit of his plant, and finding it resembles that of *A. xylocarpa*, places it—that is, *A. cibaria* or *stereophylla*—near that species, instead of next to *A. acuminata*, of which Bentham thought it might prove to be a marked variety. The fruit of our specimen, however, confirms the close affinity between *A. stereophylla* and *A. acuminata*, as pointed out by Bentham. There are several varieties of *A. acuminata* met with in the inland districts, but their pods have not been described; it is probable they may with *A. stereophylla* form a group showing affinity in all details with the typical *A. acuminata*.

NOTE ON VICTORIA REGIA, LINDL. By Professor
GIOVANNI ARCANGELI.

This plant, the most beautiful of all the species in the Nymphæaceæ or water-lily family, has been recently cultivated in the Botanic Garden of Pisa (Italy) with excellent results and very little expense, using chiefly solar heat. The germination of the seeds was carried out in a small tank of zinc, with water, gently warmed from below by a petroleum lamp. The sowing was made in the month of March or April in small pots immersed in the water of the tank. When the seedlings were sufficiently grown, with leaves 3–4 inches in diameter, one or two seedlings were planted in the bottom of a basin which was placed in a greenhouse without any apparatus for artificial warming but with glazing turned towards the south, and which was, during a large part of the day, in direct sunshine. In these conditions the seedlings, having been kept from the month of June at a temperature from 25° to 40° C., grew quite well and continued to vegetate vigorously during the months of July, August, September, and October. In the process of vegetation the plant developed a dozen and more very fine flowers, of nearly 30 cm. in diameter, which expanded successively at intervals of from three to four days. The blade of the leaf is circular in outline, in the seedlings 5–12 cm. wide and reaching at maturity 1–1.70 m. in diameter. The lifetime of each

flower was several days, and during the last few days they exhibited marked movements of nutation, rising gradually to water-level in the morning and sinking in the afternoon. The flower presented also the striking phenomenon of two successive expansions in two different days, the first in the penultimate and the second in the last day, in each case during the afternoon, the one with white, the second with red corolla, and graceful changes of colour with beautiful gradation. The plant ripened fruits with perfectly formed seeds, although without cross fertilisation.

By these experiments, accomplished in the years 1907, 1909, and 1910, we may conclude that, if *Victoria regia* may grow on pools in Sicily on open ground ("Bull. Soc. Tote. d'Orticoltura," 1907, p. 114), probably also in southern Italy, it may be grown in the plains of central and northern Italy with an appropriate greenhouse and practically using only solar heat. The trials made to cultivate this plant on open ground in our botanic garden till now have all completely failed, because by night the culture-tank being without cover is cooled by radiation; nevertheless that is not to say that under special conditions and in very hot summers the cultivation may not be successful. Meanwhile, lately, during 1911, in the same greenhouse employed for the experiments above quoted, some seeds left in the bottom of the basin from the preceding culture germinated in the month of May, without artificial heating, and two of the seedlings so obtained grew and reached maturity, producing leaves of more than 1 m. in diameter, and flourished perfectly, bearing several flowers.

I may say also that in the seeds of this plant I have been able to observe germinal asynchronism, viz. that the seeds germinate at different times, and then they may do so in different successive years, as is the case with *Euryale* and many other plants, an arrangement which is very profitable for the conservation of the species.

RECENT ADDITIONS TO THE CAITHNESS FLORA.

By ARTHUR BENNETT, A.L.S.

The Rev. D. Lillie of Watten Manse wrote me that his daughter, Miss Isabel Lillie, had collected in Caithness in 1910 and submitted her specimens to Dr. J. W. H. Trail of Aberdeen.

Dr. Trail has kindly sent me a list of what seem additions, though many are simply casuals or aliens:—

Nasturtium microphyllum, Reichb.—Watten Loch.

† *Geranium Phœum*, L.—Outside garden, Lybster.

† *Trifolium agrarium*, L.—Pasture, Stanstill, Bower.

Lathyrus montanus, Bernh., var. *tenuifolius* (Roth).—Banks of Reisgill Burn.

* *Rosa rubiginosa*, L.

* *Saxifraga umbrosa*, L.—Among trees, Lybster.

* *Sedum album*, L.—Old wall and bridge, Dunbeath.

* *Sedum stoloniferum*, S. T. Gmel.—Wall in Castletown.

Callitriche vernalis, L.—Loch Watten.

Adoxa moschatellina, L.—From South Caithness in 1908.

* *Campanula latifolia*, L.—Weed in manse garden at Watten.

† *Linaria cymbalaria*, L.—Garden walls, Swiney, Lybster.

† *L. vulgaris*, L.—Old garden, Dunbeath.

† *Mentha piperita*, L.—Forse, Latheron.

Utricularia vulgaris, L.—Probably not characteristic.

Carex curta, Good.?

† *Bromus racemosus*, L.

The following have been found by other collectors:—

Viola Lloydii, Jord.—Thurso. "Anns. Scot. N. Hist.," 1911, p. 98.

Trifolium arvense, L.—Edge of oatfield, Milton, near Wick. Mr. A. Henry sp.

† *Lamium maculatum*, L.—Roadside, edge of a wood at Castletown. Mr. A. Henry sp.

Melampyrum pratense, L., var. *montanum* (Johnst.).—Scouthall wood. Dr. Davidson sp.

These comprise about nine real additions.

Mr. C. B. Crampton has published "The Vegetation of Caithness considered in relation to the Geology" and there has added the undermentioned species to its flora:—

Corydalis claviculata, DC.—In a few places along the banks of the Langwell and Berriedale Waters. This is an interesting addition to this northern flora; it seems wanting in all Sweden, occurs very locally in W. Norway (Slavenga) and S. Norway (Christianssand), in Denmark in several places, and North Germany, but not recorded for Finland, the Faroes, or Iceland. Occurs in East (Grant sp.) and West Sutherland (Marshall sp.).

Filago minima, Fr.—Sandy places along Berriedale Water. On record for Ross and E. Sutherland, but not further north. Unknown in Finland, boreal Norway, and boreal Sweden.

Vaccinium uliginosum, L.—Northern flank of Small Mount (1750 ft.), in the Langwell Forest. Found in Sutherland, Orkney, and Shetland!.

Vaccinium Oryococcus, L.—In the Langwell Forest, near the Dubh lochs of Skielton. Recorded up to E Sutherland (Marshall, 1909).

Milium effusum L.—In the Achorn Gorge near Dunbeath. In E Sutherland Grant sp.

Melica nutans, L.—Rocky banks of the Berriedale Water with birch scrub: scarce. W. Sutherland (Marshall).

Bromus ramosus, Huds.—Achorn Gorge, near Dunbeath, and on the landslip beneath the cliff near Borgue. This is not an addition, though so given, but it being recorded under the name of *B. asper*, Murray, no doubt led to the mistake. It was found by Robert Dick at Dirlot, and I have seen it from the Forss Water.

Asplenium viride, Huds.—Rock crevices on Smean (1500 ft.). In E. and W. Ross and Shetland.

The above are an addition of seven species to the flora. The work whence these are taken enters fully into the ecological conditions of the plant-formations of Caithness from the top of Morven to the sea-coast.

The most interesting plant as regards Scotland, *Hierochloa borealis*, is not mentioned. We know from Robert Dick that the plant occurs along the Boulder Clay of the Thurso river, but it would have been of interest if the occurrence of the species had been noticed from the geological standpoint.

Mr. Crampton gives localities for other Caithness plants which are not localised in any of the published lists, as—

Carex limosa, L.—Small loch in the corrie at Yarehouse, where it grows associated with *C. dioica*, L., and *C. paniculata*, L.

Ranunculus auricomus, L.—Mr. Lillie of Swiney, Lybster, has sent me a specimen of the above species, gathered by one of the children of Boultach School, and brought to Miss Hamilton, the teacher.

This is an interesting addition to the flora, as it is not on record north of Nairn on the east coast, and of Argyll! on the west coast. In Sweden its distribution is continuous from Skane to Swedish Lapland, in Norway north to $71^{\circ} 8'$, and in Russian Lapland to 69° N. lat.

It also occurs in the Faroes, but not in Iceland.

MORPHOLOGICAL NOTES. By K. VON GOEBEL, Sc.D. (Camb.), LL.D. (St. And.), *Director of the Botanic Garden, Munich.* (Plate I.)

I. THE INFLORESCENCES OF THE AMBROSIACEÆ.

The large family of the Compositæ, as is well known, is one of those groups whose individual representatives, in spite of all their variation, still show such a close agreement in the structure of the flowers and the inflorescences that one can offhand recognise them as members of one family. Only a few groups deviate to any great extent, and of these one of the most interesting is the Ambrosiaceæ.

Ecologically they are interesting in the manner in which pollination on the one hand and the distribution of the fruit on the other hand are accomplished among them.

The Compositæ as a rule exhibit insect-pollination, but the Ambrosiaceæ have reverted to wind-pollination.

Hardly any greater contrast can be presented than between the resplendent flower-head of a *Helianthus* or a *Dahlia*, with its remarkable arrangements for dehiscence and for transference of the pollen, and the insignificant male and female floral attire of a *Xanthium* or an *Ambrosia*. There is a clear indication here that, quite apart from the lack of a corolla conspicuous in its coloration, the structure of the floral organs is in strict correlation with their functions. In the flowers no nectar is formed, there is no "concrecence" (in reality it is only agglutination or sticking together) of the anthers, and the pollen is formed in great quantity, as is the case with other anemophilous flowers. The condition of the exine indicates, however, that originally pollination took place by insects as in other Compositæ.

It is well known that the pollen in entomophilous plants is provided with a spiny or sticky exine, whereas in anemophilous plants the exine of the pollen-grains is smooth and not sticky. The Ambrosiaceæ, so far as I have been able to examine them, still show in the exine the remains of spinose thickenings such as are found in numerous other Compositæ, but these are so reduced that the pollen is no longer adapted for adhering.

The male flowers still show on the rudiment of the stigma a hairiness which recalls the "stigmatic brush" of other Compositæ. In the female flowers, in which the stamens have dwindled without leaving a trace, there is no longer any indication of this stigmatic brush. Thus the Ambrosiaceæ, in contrast to other Compositæ, are retrogressive in structure. On the other hand, it is evident that they have developed new characters not attained by other Compositæ. This is seen more especially in the character of the noteworthy envelopes with which the fruit is enclosed. The fruiting heads of *Xanthium* are well enough known to the wool-grower as the detested "burrs" (Kletten), which by means of their bent hooks attach themselves to the woolly coats of animals, and are so dispersed. We shall see that as regards these fruiting heads the other Ambrosiaceæ have also undergone retrogression in contrast with *Xanthium*.

It is not surprising that such noteworthy plants have

repeatedly formed subjects for investigation. So far as the developmental history is concerned, and apart from Payer's¹ contributions, which in the present instance need only be indirectly considered, there are available only the investigations of Rostowzew,² and these I propose in the following to supplement on some points.

Thus one topic will be the male inflorescence, while another will be the "fruit" of *Ambrosia*.

A. The Male Inflorescences.

As is known, the Ambrosiaceæ are monoecious to this extent, that the male inflorescences occupy the apex of shoots at the base of which are placed the female ones.

The individual flower-heads ("capitula") of *Ambrosia tripartita* are arranged in large numbers indefinitely (botryose) on an elongated axis, which in turn is terminated by a flower-head.

The lateral capitula have this noteworthy characteristic, that the flowers are not placed as usual on the upper (adaxial) side, but on the under side—that is, the side turned away from the primary axis of the whole inflorescence (abaxial). It is natural, at first sight, to ascribe this occurrence to a *torsion* of the flower-stalk. This is indeed the opinion of Rostowzew, who says that the flower-head undergoes a torsion, in that the peduncle grows more rapidly on its upper side than on its lower.

This interpretation in itself does not agree with the developmental history. If one examines the early stages, it is seen that the position of the capitula is "reversed" at a *very early stage*.

The capitula are differentiated from the embryonal tissue as hemispherical primordia. The cells of the primordia on the adaxial (upper) side pass first into the phase of elongation-growth, with the exception of the terminal part (*a*, fig. 1), which develops as the first leaf. On the other hand, the lower side remains embryonal. This is utilised for the development of the growing-point of the capitulum (*b*,

Payer, "Traité d'Organogénie comparée de la fleur" (Paris, 1857, p. 638).

² T. Rostowzew, "Die Entwicklung der Blüten und des Blütenstandes bei einigen Arten der Gruppe Ambrosiæ" ("Bibliotheca botanica," 20).

fig. 1), except the basal part (nearest the primary axis), which later gives rise to the intercalary meristem in the elongating peduncle of the capitulum.

How shall we interpret this peculiar development? Two different views are obviously possible.

It may be that the first leaf (α , fig. 1) arising from the growing-point of the capitulum is the first leaf of the involucre of the capitulum, the individual leaves of which, united together, form an apparently entire envelope. This is the concept of Rostowzew, which, however, has thus far to be supplemented, that the "torsion of the capitulum"—if one assumes such a thing—is not a subsequent event, but it existed from the first; in other words, it is "congenital." Rostowzew does not mention that if this interpretation be assumed, then the lateral capitula of the *Ambrosia* would present one of the rare cases in which the "bracts" (Deckblätter) of lateral shoots have aborted completely. This occurrence is known in the flowers of the cruciferae, etc., in which one can correlate the abortion of the bracts with excessive crowding originally undergone by the flower-primordia before the elongation of the axis of the inflorescence. In the case of *Ambrosia*, this would be all the more striking because the female inflorescences possess well-developed bracts, although they are quite as closely crowded together as the male ones. In no instance have I observed in the male capitula even a trace of a subtending bract.

The second possibility is that the first leaf (indicated by α in fig. 1) is the bract (Deckblatt) of the capitulum. The manner in which (α) develops from the primordium that gives rise to (α) and (b) is similar to what occurs frequently in flowers and inflorescences. In this instance the bract, so to speak, is late in being formed. It does not develop in advance of its axillary shoot, but from a primordium common to both. The thing that surprises one is that the axillary shoot should arise on the under side of the bract, and not, as usual, on the upper side. But, after all, this is no more wonderful than the "congenital torsion" already referred to, nor is it quite without precedent amongst other Dicotyledons. The remarkable flowers of *Erythrochiton hypophyllanthus* are situated on the under

side of the leaf; also the axillary branches on the creeping shoots of some of the terrestrial *Utriculariæ* arise on the side of the leaf furthest away from the growing-point.¹

In other respects it may be assumed that the position of the male capitula of *Ambrosia* means the same thing as the torsion (entirely brought about by their weight) of the male inflorescences of *Corylus*, *Alnus*, *Juglans*, or the torsion of the anther of grasses: by this means the shaking out of the pollen is facilitated in all these anemophilous plants.

Returning now to the morphological question, one might, in arriving at a decision, also take the anatomical facts into account. If (α) (fig. 1) represents the bract of the capitulum, then one might expect that the normal orientation would be shown in the constitution of the vascular bundle, phloem on the lower side, xylem on the upper. Of course, I do not regard the anatomical conditions as decisive, since, in my opinion, these are determined by the morphological, not the reverse. In the present instance this would mean that, in the event of a relatively limited development and retardation in time on the part of the bract in comparison with the axillary shoot, it appears quite natural that the former (the bract) should be provided with its vascular system from the latter (the shoot). This being so, one expects the xylem to be uppermost, with the phloem underneath.

The conditions actually existing are briefly as follows: The thin, much-flattened peduncle of the capitulum contains two vascular bundles (rarely three); the phloem-groups of these are set towards the narrow margins, and the xylems are turned towards one another and somewhat obliquely downwards (fig. 3). This anatomical structure is interesting because unusual in a shoot-axis.

A certain biassed school of anatomists assumes that shoots are distinguished from leaves by their anatomical structure, particularly in the arrangement of the vascular bundles. The shoot of the capitulum of *Ambrosia* does not differ in structure from many leaf-stalks, except that in the latter the xylem of the vascular bundle is directed upwards.

¹ K. Goebel, *Utricularia* ("Annal. du jardin botan. de Buitenzorg," vii. 1889).

There is little doubt that this anatomical structure is the result of reduction; that is, the peduncle of the primitive type possessed more than two vascular bundles. Linked with these bundles are those which ramify throughout the involucreal leaves and the flower, but I have not followed these in detail. It may be mentioned, however, that the vascular bundles of the involucreal leaves are normally orientated in that their xylem lies towards the growing-point of the capitulum. The orientation is that described above, and for the reasons given it does not seem to me possible to arrive at any definite conclusion as to the morphological interpretation of this leaf (*a*) from the anatomical structure.

It might be advanced in opposition to the view that the leaf (*a*) is a bract, that later on it does not always stand opposite the peduncle: this might, however, result from displacement. In the younger stages I saw it in the median position occupying the whole breadth of the inflorescence-primordium (fig. 4). As regards the further development of the male capitula, two facts may be pointed out. Firstly, that the external side (that on which the letter (*a*) is placed) appeared to be much further advanced than the inner side; this is seen at once in fig. 4. Secondly, that the arrangement of the flowers is not "dichasial" sympodial (as one of the recent authors wrongly states), but corresponds essentially with the other Compositæ. One sees quite clearly the broad growing-point of the capitulum (V., fig. 4), from which the individual flowers arise; some of the outer ones have bracts even now. The characteristic arrangement of the flowers is determined by the fact that the capitulum as a whole is dorsiventral in structure, with a more advanced development on the outer side.

B. The Female Inflorescences.

As indicated by Rostowzew, these are dichasially arranged (fig. 5). Each consists of a single flower enclosed by an "envelope" (fig. 8). To understand their constitution it will be necessary to first compare the inflorescences of other *Ambrosiæ*. Here one finds the following series:—

1. Mixed inflorescences with female marginal florets.
2. Inflorescences with sexes distinct, in so far that in

the female only the marginal florets flower, and only the minority of these, while in the male inflorescence the formation of female flowers is entirely suppressed.

3. There is also a diversity in the arrangement of the female and male inflorescences. Whereas the arrangement was originally indefinite (botryose), this is retained only in the case of the male inflorescences, the female ones showing dichasial arrangement.¹

In *Xanthium* the male inflorescences are orientated normally; the structure of a young male inflorescence in longitudinal section is shown in fig. 6, I. The female capitulum consists of two flowers enclosed in the many-spined envelope. This envelope originates from the fusion of two bracts (*Sa*, *Sb*, fig. 6, II.) in whose axils the female flowers are placed. With reference to the development, the reader is referred to my recent account.² This is noteworthy in this respect, that the two floral bracts entirely monopolise the growing-point of the capitulum (except what is required for the flowers arising in their axils), as is shown in the view from above (fig. 6, IV.), and that the flowers are deeply sunk in the axis of the capitulum.

Comparing this inflorescence with that of *Ambrosia*, it will be found to have undergone still further reduction. Firstly, we see that the spines or barbed hooks outside the envelope are here reduced to a few small processes (figs. 7 and 8, *st*); secondly, each envelope contains only one flower. The processes referred to can no longer be of use in the dispersal of the fruits by animals.³ How dispersal is effected can only be ascertained in the native land of the plant. The fruits are relatively light, and float in water for a short time at least, and they may even be rolled to a distance by wind.

It is evident that the envelope of the fruit of *Ambrosia* corresponds to that of *Xanthium*. But is it, like the

¹ With regard to diversity of male and female, compare Goebel, "Ueber sexuellen Dimorphismus bei Pflanzen" ("Biolog. Centralblatt," p. 657, 1910)

² Goebel, *l.c.* ("Biolog. Centralblatt," xxx., 1910, p. 722).

³ They might, of course, become lodged between the claws or in the hoof.

former, a double one, or is it single? That there is some suggestion of a double envelope is evident by the fact that the apex of the envelope (originally laid down as a closed ring; see fig. 7, right-hand figure) is distinctly two-lobed in the later stages of growth. This indicates that two leaf-primordia take part in the formation of the envelope. Only one of these, however, has an axillary flower-primordium. Obviously a characteristic retrogression has taken place here: the flower monopolises the whole area within the envelope; hence it arises not as a lateral outgrowth on the growing-point of a capitulum, but is terminal. There are, of course, many examples of an organ genetically lateral in origin becoming ultimately terminal. We may cite the spikelets of many grasses, also the carpels which in many flowers monopolise all the residual part of the growing-point of the flower, and the terminal stamen of *Naias*, *Callitriche*, etc. *Ambrosia* is, however, a specially well-marked example of this procedure. The development of the female flower need not be described further, except to point out that there is only a mere trace of the corolla, while the stamens and calyx have disappeared without leaving a trace.

Thus we see that *Ambrosia* has carried still further in its female inflorescence that reduction already indicated in *Xanthium*. Even in *Xanthium* the male organs of the capitulum are completely suppressed and the number of female flowers is reduced to two. As new structures there are present the hook-like spines on the outside of the crescent floral-bracts, which, taking the place of the pappus originally present, facilitate dispersal of the fruit. In *Ambrosia* these spines dwindle to a few rudiments and the number of flowers diminishes to a single one.

In the male inflorescences, however, the number of capitula is probably increased considerably in comparison with the type-form with hermaphrodite flowers. With this may also be correlated, that these male capitula have departed from the prevailing scheme of development, and as seen in their "reversal" have progressed along new lines. Thus with no great effort, and with a basis of facts admissible in any new speculation, we are able to trace, in what seems to me a satisfactory manner, the historical evolution of the structure

of the inflorescences of *Ambrosia*. At the same time, the case dealt with here illustrates once again the phenomenon to which the author has frequently made reference; namely, that our phylogenetic series, so far as we can depict them with any degree of probability, all represent a reduction-series.

The following may be advanced in support of this:—

1. In a descending series we have a definite starting-point (that is, some one of the more completely equipped forms as distinct from the more reduced ones) with which we can compare the less completely equipped members of the series.
2. In many instances the organs in question may still be recognised as rudiments.
3. The descending series arise latest; hence they are more completely preserved and easier to recognise than the ascending with a history extending much further back, and whose members are as a rule very incompletely preserved.

Descending series of this kind are known to every botanist, since they appear again and again in almost every family. Other facts also indicate that organisms become modified mainly through retrogression and simplification: thus "mutations," for example, are essentially of this nature, since in them there is a loss of some definite characteristic.¹

Has then the "nisus formatoris" of the ancient philosophers itself become antiquated? Not at all; botany at least has remained youthful. To be convinced of this, one need only glance at what is only possible where youthful aspirations exist, namely, the construction of genealogical trees from below upwards. "Alas, alike in their tenure of life, they are mostly ruins, not of the trees, however, but of the ephemeral day-flies!"

¹ E. Baur, "Einführung in die experimentelle Vererbungslehre" (Berlin, 1911), says: "The large majority of mutations which have been closely investigated depend simply on the loss of some single Mendelian unit character. I have not found up till now, any absolutely certain case in which one or more unit characters have arisen *de novo*."

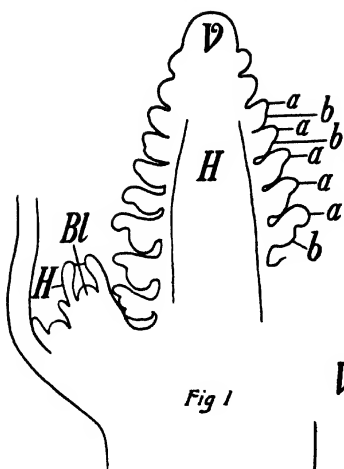


Fig. 1

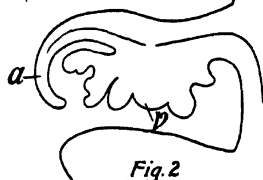


Fig. 2

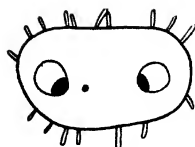


Fig. 3

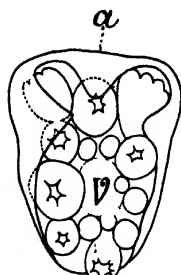


Fig. 4

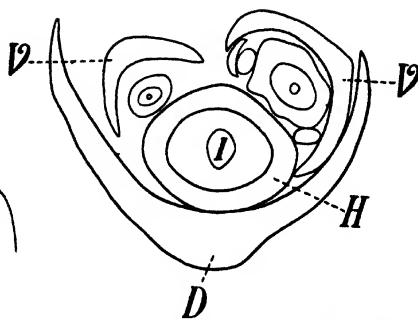


Fig. 5

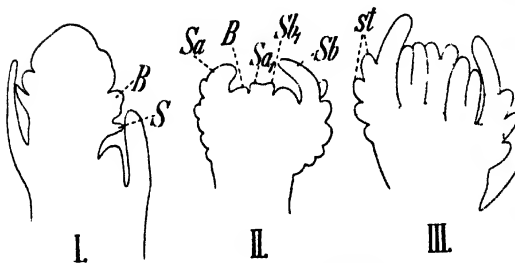


Fig. 6

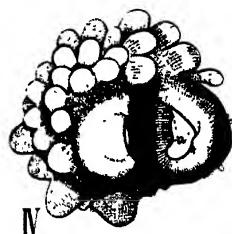


Fig. 7

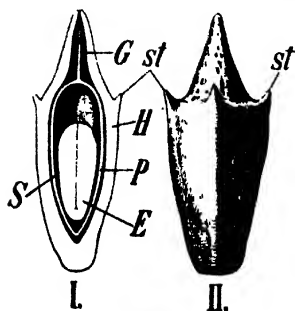


Fig. 8

EXPLANATION OF THE FIGURES.

Fig. 1. Longitudinal section through an inflorescence of *Ambrosia tripartita*. V, growing-point of the male inflorescence; the individual capitula (with the exception of the terminal one) are placed laterally on the primary axis. *a*, the first leaf of a male capitulum of which *b* is the growing-point. *Bl*, female flower with its envelope, H.

Fig. 2. *Ambrosia tripartita*. Longitudinal section through an older male capitulum. V, the growing-point.

Fig. 3. Transverse section through the peduncle of a male capitulum of *Ambrosia tripartita*. The xylem in each of the two large conductive bundles is shaded.

Fig. 4. Capitulum of *Ambrosia tripartita* seen from above. Around the growing-point, V, there are seen fifteen embryonal flowers in various stages of development; the involucre surrounds the whole.

Fig. 5. *Ambrosia tripartita*. Transverse section through a young female inflorescence-group. In the axil of a bract (Deckblatt), D, is a one-flowered female inflorescence, I, with its envelope, H; this has two prophylls (Vorblätter), V, in the axils of which other inflorescences are present.

Fig. 6, I.-III. *Xanthium spinosum*.

- I. Longitudinal section through a young male inflorescence. B, male flower with its bract, S.
- II. Longitudinal section through a female inflorescence. *Sa*, *Sb*, the bracts (Deckblätter) of two flowers, *Sa*₁, *Sb*₁, which on the side towards the incurved margins of the bracts are proceeding to develop the floral organs.
- III. Older inflorescence in which each female flower has now the stigma developed, *st*.

IV. *Xanthium strumarium*. A young female inflorescence seen from above.

Fig. 7. *Ambrosia tripartita*. On the left a female inflorescence, seen from the outside. *st*, primordia of the spines which remain rudimentary. H, the envelope (clearly two-partite). *Bl*, flower-primordium seen through the envelope (which is regarded as transparent). On the right a young inflorescence seen from the outside.

Fig. 8. *Ambrosia tripartita*.

- I. Fruit with its envelope, bisected longitudinally. H, envelope; *st*, spines; P, pericarp; S, seed-coat (very thin); E, embryo.
- II. Fruit with envelope seen from outside.

NOTES ON SOME MOSSES FROM THE THREE LOTHIANS.

By JAMES M'ANDREW.

Perhaps the following notes may prove interesting to local and Scottish bryologists. They consist principally of new records of British mosses gathered in the Lothians since the "Census Catalogue of British Mosses" was published in 1907. I am indebted to Mr. William Evans, Edinburgh, for about one-half of them; the others were gathered by myself and from time to time reported to Mr. R. H. Meldrum, and will no doubt in due course appear in the next edition of the "Census Catalogue."

HADDINGTON, v.c. 82. *Sphagnum cymbifolium* Ehrh.; *S. rigidum* Schp.; *Andreaea petrophila* Ehrh.; *And. Rothii* W. and M. (Traprain Law, East Linton); *Polytrichum urnigerum* L.; *P. alpinum* L. (Traprain Law); *P. formosum* Hedw.; *Pleuridium subulatum* Rabenh.; *Rhabdoweisia fugax* B. and S. (Traprain Law); *Dicranella squarrosa* Schp.; *Blindia acuta* B. and S. (Traprain Law); *Grimmia apocarpa* Hedw., var. *virularis* W. and M. (East Linton); *G. patens* B. and S. (Traprain Law); *G. decipiens* Lindb. (Traprain Law—cum fructu); *G. montana* B. and S. (Traprain Law); *G. Stirtoni* Schp. (Garleton Hills, by W. Evans); *Racomitrium protensum* Braun (Traprain Law, by W. Evans); *R. canescens* Brid., var. *ericoides* B. and S.; *Hedwigia imberbis* Spruce (Traprain Law); *Pottia bryoides* Mitt. (Gosford Bay, by Mr. John Hunter); *Barbula fallax* Hedw., var. *brevisfolia* Schultz (west of Dunbar); *Weisia microstoma* C. M. (Gosford Bay); *Cinclidotus fontinaloides* P. Beauv. (river Tyne); *Zygodon Mougeotii* B. and S. (Traprain Law); *Orthotrichum stramineum* Hornsch.; *Bartramia pomiformis* Hedw., var. *crispa* B. and S. (Traprain Law); *Leptobryum pyriforme* Wils. (W. Evans); *Plagiobryum Zierii* Lindb. (Traprain Law); *Webera prolifera* Bryhn (W. Evans); *Bryum alpinum* Huds., and var. *viride* Husn. (Traprain Law); *B. argenteum* L., var. *lanatum* B. and S. (Gullane Links); *Mnium stellure* Reich. (Gullane Links); *Pterygophyllum lucens* Brid., and *Heterocladium heteropterum* B. and S. (Traprain Law); *Brachythecium salebrosum* B. and S. (Gullane Bay); *B. plumosum*

B. and S. (East Linton); *Plagiothecium pulchellum* B. and S. (Traprain Law); *Amblystegium serpens* B. and S., var. *salinum* Carr. (Gullane Links); *Hypnum elodes* Spruce; *H. aduncum* Hedw., var. *paternum* Sanio (all Gullane Links); *H. Sendtneri* Schp. (Gullane Links). Regarding this moss Mr. J. A. Wheldon, F.L.S., Liverpool, writes me: "Your plant is typical *H. Sendtneri* Schp. It is new to Haddingtonshire, and as a matter of fact it is the first specimen I have seen from Scotland, although recorded from v.c.'s 86 and 87. I have for years been trying to get a specimen of the inland plant, but without success so far." It grows in a shallow lagoon on Gullane Links, and covers the whole bottom with a mass of several acres exclusively of this moss. *H. fluitans* L.; *H. cupressiforme* L., var. *filiforme* Brid.; *H. Patientiae* Lindb.

Traprain Law, East Linton, has several very interesting mosses such as *Helwigiæ imberbis* Spruce; *Grimmia montana* B. and S.; *Grimmia decipiens* Lindb., all three in great abundance, the latter in fruit; *Andreaea Rothii* W. and M.; *Bryum alpinum* Huds. Gullane Links also, like Tents Muir, Sands of Barrie, Dunbarnie Links, etc., have several rare mosses already recorded as *Ditrichum flexicaule* Hpe., var. *densum* B. and S.; *Swartzia montana* Lindb., and *S. inclinata* Ehrh.; *Barbula Hornschuchiana* Schultz; *Trichostomum flavo-virens* Bruch; *Encalypta rhabdocarpi* Schwæg.; *Amblyodon dealbatus* P. Beauv.; *Meesia trichoides* Spruce; *Cutascopium nigrum* Brid.; *Bryum calophyllum* R. Br.; *Amblystegium filicinum* De Not., var. *Whiteheadii* Wheldon; *Hypnum chrysophyllum* Brid.; *H. giganteum* Schp., *Thuidium recognitum* Lindb., etc.

EDINBURGH, v.c. 83. This vice-county has been better searched for mosses than the two adjoining counties, and hence the new records for it are fewer. *Sphagnum cuspidatum* Ehrh. var. *submersum* Schp.; *S. molle* Sull.; *Polytrichum strictum* Banks (all from Bavelaw Moss); *Oligotrichum hercynicum* Lam., recently got in Corstorphine Hill wood, is now extinct; *Fissidens crassipes* Wils. (Colinton Dell); *Barbula Hornschuchiana* Schultz (waste ground north of Donaldson's Hospital); *Physcomitrella patens* B. and S. (Torduff reservoir, by Mr. W. E. Evans.

I got this moss in plenty on the dried-up bottom of a lagoon west of S. Queensferry last year); *Bryum argenteum* L., var. *lanatum* B. and S.; *Brachythecium glareosum* B. and S. (Flotterstone Bridge); *Hypnum polygamum* Schp.; *H. aduncum* Hedw., var. *polycarpon* Bland.; *H. fluitans* L., var. *Jeanbernati* Ren., and var. *atlanticum* Ren.; *H. exannulatum* Gümb., var. *pinnatum* Boul., f. *stenophylloides* Ren., and var. *pinnatum* Boul., f. *gracil-escens* Ren.; *H. intermedium* Lindb., var. *tenellum* Roth (= *H. pellucidum* Wils.) (all in Bavelaw Moss); *H. cupressiforme* L., var. *tectorum* Brid.; *H. imponens* Hedw. (Bavelaw Moss). I got this also last year near West Linton in Peeblesshire, v.c. 78.

LINLITHGOW, v.c. 84. *Sphagnum rigidum* Schp., and var. *compactum* Schp.; *S. cymbifolium* Ehrh.; *S. tenellum* Ehrh.; *S. fimbriatum* Wils.; *S. Girgensohnii* Russ. (all in Drumshoreland Moss); *Pleuridium subulatum* Rabenh.; *P. alternifolium* Rabenh. (N.B. railway embankment); *Cynodontium Bruntowi* B. and S. (Cocklerue); *Fissidens recurvus* Starke; *Barbula lurida* Lindb.; *Barbula Hornschuchiana* Schultz; *Physcomitrella patens* B. and S. (all west of S. Queensferry); *Bartramia ithyphylla* Brid., *Leptobryum pyriforme* Wils. (Kirkliston distillery); *Weberia annotina* Schwæg. (Drumshoreland); *Byrum alpinum* Huds. (Cocklerue); *Thuidium recognitum* Lindb. (west of S. Queensferry); *Hypnum riparium* L. (Linlithgow Loch); *H. stellatum* Schreb., var. *protensum* Rohl; *H. exannulatum* Gümb.; *H. cordifolium* Hedw. (Drumshoreland curling pond); *H. loreum* B. and S. (W. Evans).

In the "Census Catalogue of British Mosses" for 1907 there are several mosses which require rediscovery, for their records are old. For instance, the rare *Grimmias* on Arthur's Seat have evidently disappeared. *Grimmia leucophaea* Grev., is the last one of the group I have seen on Arthur's Seat, and I suspect that now it too is extinct. The following among others require refinding:—*Sphagnum Austini* Sull. (v.c. 83); *Bryum Warneum* Bland. (v.c. 82); *Cryphaea heteromalla* Mohr (v.c. 82); *Hypnum eugyrium* Schp. (v.c. 83); *Grimmia orbicularis* Bruch (v.c. 83); *G. anodon* B. and S. (v.c. 83); *G. conferta* Funck (v.c. 83); *G. commutata* Hübn. (v.c. 83); *G. ovata* Schwæg. (v.c.'s 82

and 83); *Antitrichia curtipendula* Brîd. (v.c. 83), and several others. *Trichostomum mutabile* Bruch; *T. inclinatum* Dixon; *T. nitidum* Schp., have yet to be gathered in v.c. 82.

SAXIFRAGA HIRCULUS, L., IN CAITHNESS, AND ITS DISTRIBUTION IN THE BRITISH ISLES. By ARTHUR BENNETT, A.L.S.

Mr. G. Lillie has kindly sent me good flowering specimens of the above species which he found growing "in a floating bog about ten yards across each way. It was very shaky, but there was not much danger of one sinking in it as there was considerable growth of grasses, plants, and mosses." It occurred between Lybster and Loch Rhuard, altitude 430 feet, 58° 22' N. lat., about 1½ miles from the loch. The loch itself afforded *Lobelia Dortmanna* and *Subularia aquatica*, rare plants in the county. As the water from the loch and the stream running into it is discharged into the Loop river, thence to the Little river, and finally into the Thurso river, the plant belongs to the north-west watershed, not to the east.

S. Hirculus is not on record north of West Perth and Kincardine, 57° N. lat.; the extension of range north to Caithness is interesting, though it is a high arctic and northern species.

As a rare species it may be well to summarise its distribution in our Isles.

91. Kincardine. Wet moor on the farm of Jacksburns, Glenbervie. 21.6.1839.—Mr. James Rae. This is the station erroneously given in "Topl. Botany" as "Aberdeen, J. Rae."

87. Perth, W. Madie Moss, above Tillicoultry, c. 2000 feet. Northern side of the Ochils, Clackmannanshire — Mr. W. Thompson.

83. Edinburgh. On a wet moor between Fala and Stow. —G. J. Blackie. Three miles beyond Blackshiels, Pentland Hills, Midlothian. 11.8.98.—F. C. Crawford sp.

81. Berwick. Moor south of Langton Lees farmhouse, plentiful.—Dr. Johnston, c. 1831; sp. Cardiff Museum !.

78. Peebles. Pentland Hills, source of the Medwin, about 1000 feet. 11.9.1836.—Dr. A. Hunter. J. H. Balfour sp., 19.9.1838.

77. Lanark. Boorland Moss, Walston, Sept. 1850.—G. F. Blackie. No altitude given, but the parish ranges from 660 to 1000 feet alt.

69. Westmoreland. Neathheath Syke, alt. 1800 feet, Sept. 1840.—John Bell. Backhouse in Herbarium, York!.

66. Durham. Wet moor, Inishope, Weardale, 2.8.1885.—J. P. Soutter sp.

65. York, N.W. Sedbergh.—J. Handley, "Yorkshire Naturalist" (1903), p. 408. Cotherstone Fell, 1847.—D. Oliver sp. The actual station is swamps at the junction of the river Balder with the Black Beck. Discovered here by J. Backhouse, 1810; sp. in York Herbarium.

58. Cheshire. Knutsford Moor, where it was associated with *Andromeda*, *Melampyrum pratense*, *Carex limosa*, *curta*, and *stellulata*;¹ also with *Sium angustifolium*, *Cicuta*, *Potamogeton polygonifolius*, *Carex ampullacea*, *Lastrea spinulosa*, *L. thelypteris*, and *Osmanda regalis*.

The date of its first record here (and for Britain) is 1724, Dill. in Ray, "Syn.," 3rd ed., p. 355; but the plant had been gathered some time between then and 1696, as in an old volume of coloured impressions of Cheshire plants² the locality is given, and the names are those of the 2nd ed. of the "Synopsis." Specimen sent from here by Mr. Okell of Chester, and figured in "Eng. Botany," t. 1009,³ Aug. 1801. Extinct in 1842. The species did not become extinct here altogether through natural causes, as the following extract will show:—

"Still exists on Knutsford Moor, but is almost destroyed by the rapacity of some individuals who have dug it up for sale in the most remorseless manner."—Dr. J. B. Wood, in "Phytologist," i. (1842), p. 282.

In Ireland in the middle and north-east (*i.e.* in six of Mr. Praeger's divisions), but characterised as very rare.

In Europe it is a species of Arctic Norway to 69° 29' N. lat., Swedish, Finnish, and Russian Lapland, Iceland,

¹ Lord de Tabley, "Fl. Cheshire" (1899), p. 142.

² Perry, "Phyt.," i. (1843), p. 700.

³ This plate is not quoted in the 3rd ed., iv. (1865), t. 550.

along the Siberian coast to Behring's Straits.¹ The American Arctic coast to Labrador, south to Saskatchewan, E. and W. Greenland, as var. *alpina*, Engler Mon. Warming, "Om Groenlands Vegetation," 1886-7, does not give any height for this, though citing many species up to 4000 feet. It will bear intense cold, as on the island of Kolegew, where "the thermometer never rose above 9° R. in July and August 1841";² there it is common. It also occurs on Spitzbergen and Bear Island.

I am not sure whether the first Scottish record was the Berwick one in Watson's "Outlines," 1832, or the Black-shiels one in the "Edin. Phil. Journal," as I have not access to the latter. It is not given in Dr. Johnston's "Flora of Berwick," ii., 1831.

Along with the Saxifrage there was a form of *Cerastium vulgatum*, L. (*triviale*, Link), which looked very different from the ordinary form of the species, no doubt induced by the place of growth. Still thinking it might be one of the Swiss forms so found, I sent specimens to Dr. Schinz of Geneva; he referred them to Dr. Keller of Berne. Dr. Keller reports: "They are only a form of *C. caespitosum*, Gilib.³ (= *vulgatum*, Wab.), but the plant ought to be observed. Like all species of *Cerastium*, *caespitosum* shows a great variation in all parts according to the medium in which it lives." Dr. Keller writes: "*C. vulgatum*, L. (= *glomeratum*, Thuill., *viscosum*, Fr.)," which opens the door to a war of words. One accepts the decision: at the same time, the plant is easily distinguished by the eye. Another addition to the county was growing with it—*Ranunculus scoticus*, Marshall.

A NEW SPECIES OF PYRENOCHLOETA. By MALCOLM WILSON, D.Sc., F.L.S.

This plant was discovered by Mr. Wm. Nowell in considerable quantity during the summer of 1911 on dead Holly leaves on Wimbledon Common, near London. In size it

¹ Kjellman, "Vega Expedition" (1882), 263, 302.

² Erman, "Arch. Wiss. Kunde v. Russlandes" (1852), x. 313-16; quoted by Fielden and Geldart, "Trans. Nor. and Norf. N. Soc." (1896), p. 169. ³ Gilibert, "Fl. Lithuanica," v. (1782), p. 159.

exceeds most of the species of *Pyrenochaeta*, the diameter of the perithecium being about 1 mm. when the setæ are included. Numerous brown septate hyphæ pass from the base of the perithecium and penetrate the tissues of the host in all directions.

Pyrenochaeta Ilicis, n. sp. — Peritheciis amphigenis, sparsis, ovoideis vel subglobosis, 3–5 mm. diam. innatorumpentibus, subcarbonaceis, atris, setis multis, nigris, rigidis, continuis, 200–400 μ superne vestitis; ostiolo prominulo, rotundo; basidiis filiformibus, alterne ramulosis, ramulis brevibus; sporulis cylindricis, utrinque obtusis, continuis, hyalinis, 6–7 = 1–2 μ .

Hab.: In foliis dejectis *Ilicis Aquifolii*, Wimbledon in Britannia.

Considering the abundance of the host it is rather surprising that no record of this fungus has been previously published.

AGATHOSMA TRICHOCARPA, N. SP.

By E. M. HOLMES, F.L.S. (Plate II.)

Since the publication of Harvey and Sonder's "Flora Capensis" many undescribed specimens of rutaceous plants have been detected in Cape Colony, and not a few of these have as yet remained unnamed in herbaria. The species of the genera in the Diosmeæ, in particular, are so closely allied that it is difficult in the absence of complete material to separate one species from another. The plant to which I have given the above name occurs in herbaria under a number only, as No. 5240, Schlechter, "Plantæ Afric. Austr." The specimen I received was in fruit, and was sent to me as a variety of *Buchu* used in S.E. Africa by the natives, by Mr. Stephen R. Webb, and was collected by Dr. Froembling.

On comparing it at the Kew Herbarium, a specimen identical with it, but without flowers, was found there, and subsequently a specimen of the same plant in flower was met with in the Natural History Museum at South Kensington.

Dr. F. Schinz of Zurich having paid much attention to

this group of plants, I wrote to ask him if it had been described as yet, since it is not easy to keep pace with recent publications unless one is working at a group and can look up all the literature up to date. He assured me that it had not yet been described. I therefore thought it desirable to publish a description and figure of the plant, which is here given:—

Agathosma trichocarpa, n. sp. — Fruticulus erectus, ramosus, ramis erecto-patentibus, apicem versus fastigiatis, subcorymbosis; ramulis angularibus, dense foliatis, florentibus purpureo-rubris, pilis et glandulis obtectis; foliis parvis, sessilibus, lineari-lanceolatis obtusis, inferioribus longioribus reflexis, 6 mm. longis, 1-2 mm. latis supra planis vel subcanaliculatis; margine glanduloso-ciliatis; glandulis pluricellariis; floribus in capitulis paucifloris, pedicellatis dispositis, bracteis paucis linearibus ciliatis; calyce glabro, segmentis lanceolatis obtusis, 1.5 mm. longis, et 1 mm. latis, nervo unico, crasso, glandulis biserialibus immersis præditis, petalis albis, 4 mm., calycem superantibus, obovato-oblongis obtusis, in unguem gracillimum extenuatis; utrinque glabris; staminibus fertilibus quinque, antheris glandulâ apice coronatis, staminodiis infra lineari-lanceolatis pilosis, apicem versus glabris valde angustatis, apice glandulâ minimâ coronatis: disco cupuliformi, stylo filiformi glabro, carpellis inferne glandulosis, apicibus rostratis recurvis, pilis longis coronatis; seminibus nigris nitidis.

Hab.: In regione occidentali, Africæ Australis, S. R. Webb, Legit Dr. Froembling, 1911.

Syn.: *Agathosma*, nov. sp., R. Schlechter, in planitie summi Mont Piquetberg, 530 m., ix. 9. 1894, No. 5240, Schlechter, "Pl. Afric. Austr."

The present species resembles *A. alpina*, Schlechter ("Journ. Bot.," 1898, p. 25), in the hairy tips of the carpels, but differs in the angular twigs, the longer pedicels of the flowers, the few-flowered umbels, the thread-like ends of the staminodes, and the glabrous style.

I am indebted to Dr. Schinz for a small specimen of a flowering twig of the plant and to Dr. A. B. Rendle, M.A., for kindly allowing me to dissect a flower of the British Museum specimen of Schlechter's plant, No. 5240.

EXPLANATION OF ILLUSTRATION.

- a. Twig in fruit, natural size, received from Mr. S. R. Webb.
 - b. Flower cut open, received from Dr. Schinz as No. 5240 Schlechter.
 - c. Calyx separated, showing position of double row of immersed oil glands.
 - d. Showing disc and hair-tipped carpels, and glabrous style.
 - e. Petal.
 - f. Fertile stamen.
 - g. Staminode.
 - h. Fruit.
 - i. Seed.
- The figures b to h are magnified.

A NEW JAPANESE GRATELOUPIA. By E. M. HOLMES,
F.L.S. (Plate III.)

Amongst some marine algæ collected in Japan by Mr. S. Okubo, and brought to me for identification, I noticed one which I was unable to match either at the Kew Herbarium or at South Kensington. Although bearing some resemblance to *Grateloupia filicina*, it differs so much in habit and colour that I have decided to describe it as a new species.

Grateloupia subpectinata, n. sp. — Fronde compressa, plana, ad 15 cm. longa, et 3 mm. lata, pinnatim ramosa, ramis a basi angustiore, longe subuliformibus, inferioribus longioribus, infra medium latere inferiori ramellis brevibus subpectinatis, latere superiori dentibus paucis præditis, ramis supremis simplicibus, brevibus. Color pulchre roseus.

Hab.: Japan, S. Okubo, 1912.

The nearest approach to this species, in the mode of branching, is *Grateloupia Pennatula*, Kuetzing, a native of Cuba ("Tab. Phyc.," vol. xvii., tab. 27, a, b), which has similar ramelli, but both the ramuli and ramelli are lanceolate-linear rather than subuliform, and are much shorter in proportion. The rose colour, so far as I know, is never found in forms of *Grateloupia filicina*, although I have seen many forms referred to this species. The structure is, however, typical of *Grateloupia*, and not of loose texture as in the section *Gloiogenia*, to which a rose-coloured species, *G. acuminata*, from Japan, previously described by me, belongs.



Agathosma trichocarpa, nov. sp.

E. M. HOLMES.



Grateloupia subpectinata, nov. sp.

KENFIG BURROWS: AN ECOLOGICAL STUDY.

By M. Y. ORR.

Kenfig Burrows forms the southern extremity of a fringe of blown sand which borders the south-west coast of Glamorgan as far as Swansea, a distance of fifteen miles. The breaks in its continuity are brought about by the rivers Avon and Neath. At Kenfig the sand dunes extend inland for over two miles at the broadest part, and occupy an area of approximately 1500 acres. The general drift of the sand is in an easterly direction.

Apart altogether from the biological problems involved, the area is of great historical interest, for a waste of sand now covers what was at one time a prosperous town. A few scattered ruins on the northern dunes are all that remain to mark the site of the castle and buried city of Kenfig. The invasion of the sand since Roman times appears to have been gradual, but, according to tradition, sand storms of considerable magnitude occurred in the fourteenth century. In 1538 ruin had overtaken the town and castle, and both were abandoned to the advancing sand.

Kenfig is now represented by a little hamlet, situated about half a mile from the castle ruins, on a ridge overlooking the sheet of water known as Kenfig Pool. This water occupies the central portion of the landward margin of the dunes. From its eastern shore the ground slopes gradually upwards to the ridge, the height of which, and of the adjacent fixed dunes, varies from ninety to one hundred feet above sea-level. The pool forms the apex of a triangular wedge of fertile land which has not been invaded by the sand to any great extent. No doubt, the pool, owing to its position, forms a natural barrier to the further incursions of the sand. The area of this sheet of water is 68 acres, and its greatest depth is 11 feet. The water is fresh and fed by springs on the landward side. It has existed in its present form since 1876, but is of less extent and slightly different outline to the pool of 1814. It was originally a marsh, and its eastern margin is still, in part, characterised by a marsh vegetation. At that

time it was drained by a stream which flowed in a northerly direction and emptied itself into Kenfig river. To-day there is no visible outlet, but it is possible that its waters filter through the sand and ultimately enter the river in that way.

Geology, Climate, and Rainfall.

The blown sand rests on the Keuper marls of the Trias formation. Rocks which project here and there through the sand nearly all consist of conglomerate, which is more or less calcareous in composition. The wedge of land which has the pool as its apex is boulder clay resting on Triassic conglomerate, while the southern boundary of the "white" dunes is of like glacial origin. A broad stretch of alluvium marks the northern limit, and an irregular alluvial tract extends from the margin of the pool to within a short distance of the shore. The climate is mild and humid. Owing to the prevalence of warm south-westerly winds the mean January temperature is about 41° F., and it is probable that the resultant mild winters have a modifying effect upon the vegetation. The corresponding July temperature is 62° F. The average annual rainfall, estimated over a number of years, is a little over 33 inches. The wettest months of the year are July to January inclusive. A complete analysis of the soil and sand taken from different stations on the dunes is now being carried out, and a detailed account of soil conditions will be embodied in a future publication. Cattle and horses are pastured on the dunes, and the soil is thus enriched with manure. Molluscan shells are abundant in many of the hollows.

The plant formation which covers this area is a natural one, and presents many interesting biological features. A comprehensive ecological study of its vegetation, on modern lines, is now being undertaken, and it is hoped to extend this investigation so as to include the entire belt of sand dunes from Porthcawl to Swansea. So far, detailed observations have been chiefly confined to the Kentig district. This communication is, therefore, not intended to be exhaustive, and is merely a brief account of the more salient features of the vegetation.

THE PLANT ASSOCIATIONS.

The three most prominent and well-marked associations in this formation are the following: 1. The association of *Ammophila arenaria*; 2. the association of *Salix repens*; 3. the association of *Pteris aquilina*.

1. The association of *Ammophila arenaria*.—This association is characteristic of the "shifting" dunes, with the Marram grass as the dominant species. This species occupies the first seaward line of sand hills, the *Agropyretum juncei* (sea couch-grass association) of the Somerset and Lancashire dunes being practically absent in this area. It is worthy of notice that *Elymus arenarius*, which in Norfolk gives rise to low dunes, is entirely absent from this coast. The higher inland dunes, many of them over fifty feet in height, bear on their crests the characteristic tufts of Marram grass. It descends on the leeward slopes and colonises the sandy hollows, and in many of the latter its rhizomic habit of growth is particularly obvious. As a "sand-binder" it is pre-eminent, and it is interesting to note that in the Charters of Kentig of 1330 special provision was made for its protection and preservation. *Ammophila* also occurs in abundance on some of the "fixed" dunes.

2. The *Salix repens* association.—*Salix repens* occurs on the "shifting" dunes as a "sand-binder," producing a well-marked association. In the sandy dune valleys it forms a carpet of low-growing scrub, but in the more exposed stations it collects around it the blown sand and gives rise to "hummocks" and small dunes. In the damp hollows it forms a fringe round the marshy ground and the dependent species vary accordingly. *Salix* represents the second stage in succession on the dunes, as *Ammophila* represents the first. In the more open stations of this association Marram grass is the subdominant species. *Salix repens* occurs on the Lancashire dunes, but Moss describes it as a comparatively rare plant on the Somerset sand hills.

3. The *Pteris aquilina* association.—The bracken covers acres of the "fixed" dunes in this area, and its outliers blend with the willow of the preceding association. Its

rhizomic habit of growth makes it likewise a successful sand-binder, and it forms the last stage in succession. According to Massart, *Pteris* is entirely absent from, or very rare on, the Belgian dunes. It has here undoubtedly adapted itself to life on the dunes and grows luxuriantly. The fronds are regularly harvested for cattle-bedding. Although it is such an abundant type on the "grey" dunes near Kenfig pool, it is sparsely represented on the adjoining boulder clay. This may be due, in part, to the fact that the latter is under cultivation, or perhaps its absence may be accounted for by the more or less calcareous nature of the clay; the bracken being regarded by some authorities as a calcifuge.

In these three chief associations the subordinate species vary according to the character of the association. The Marram grass association is essentially an open one, and on the seaward side of the first range of "mobile" dunes it is an almost pure association. As a result of this open character, competition among the associated species is reduced to a minimum. The *Salix repens* association is of a less open nature. The habit of growth of the *Salix* affords protection from blowing sand, and excessive insolation, to the types which it shelters. At the same time, a certain amount of humus is present, especially in damper stations. On the embryonic dunes formed by this species few associated plants occur, principally on account of the more exposed situation. These hummocks are subjected to frequent denudation by the wind, and their bases commonly present a weathered appearance. In the fixed dune association where *Pteris* is the dominant plant, the amount of shade cast by its fronds is relatively greater, and the dependent species are mostly grasses, *Agrostis* sp., etc. These three dominant species are rhizomic in habit, and are specially adapted to hold their own under apparently unsuitable edaphic conditions.

Extent and Distribution of these Associations.

The Marram grass association extends inland as far as Kenfig Pool, where its outlying stations dovetail with those of the *Salix* association. This latter covers a broad area on the alluvium on the seaward side of the pool, and extends

laterally on its flanks. It gradually loses its identity in the bracken association of the fixed dunes. Distributed throughout these chief associations are minor associations which are of local occurrence. *Rubus cæsius*, the dewberry, for instance, forms a community of this description. This species occurs in certain situations on the dunes, and represents, with *Pteris* and *Salix*, the last stages in succession. Sometimes associated with it is a hybrid form of *Rubus* which gives rise to hummocks. In addition to these principal associations many sub-associations and plant societies exist. These will be described at a later stage.

The term "plant association" implies a plant community, and it therefore follows that the dominant types, mentioned above, have associated with them species which may be regarded as subdominant, abundant, or occasional, according to the frequency of their occurrence. Some species are apparently always associated with a particular dominant, but on the dunes there are many cosmopolitan types which are not limited in their distribution to any one association. A list of subordinate species occurring in any one plant community does not therefore imply that they are characteristic of that association alone, or that they do not occur as frequently in any other association. The majority of associated species colonise the sheltered "flats" and dune valleys which wind in all directions among the high dunes. The configuration of these valleys is varied, and some are characterised by a flora quite distinct in composition from that of a neighbouring depression. Some are marsh-like in character, while others are undulating plains of blown sand, with embryonic dunes in various stages of formation. The species which occupy the dry hollows are psammophilous, although some, like *Cnicus arvensis*, which frequently occurs, are as characteristic of other formations. On the fixed dunes sward-forming plants and others are associated with *Pteris* and *Ammophila*, while many species of moss form patches of bright green colour everywhere, and are particularly obvious during the early spring.

The following detailed description of the associations is not intended to be exhaustive. Many problems arising out of the distribution of the dependent species in this formation have yet to be solved, and the listing of associated types is

but a step on the way to their complete elucidation. No sharp line can be drawn between two associations, and it is often difficult to determine whether a certain species belongs to one association or to another.

In the Kenfig sand-dune area the *Salix repens* association is of a transitional type. In its more open stations on the mobile dunes the majority of its subordinate species are those of the Marram grass association. Towards its inner limit, fixation of the sand is complete, and the included species are those of the fixed dunes.

Before enumerating the species which are found in the chief associations, it is necessary to call attention to the plants which occupy the foreshore, above high-water mark. These plants are usually included in the sand-dune formation, although, as a rule, they are more of a halophilous nature. This association of strand plants is not well developed on this part of the coast; only a few species occurring here and there. The following are the commoner species: *Cakile maritima*, Scop.; *Arenaria peploides*, Linn.; *Salsola Kali*, Linn.

Marram Grass Association.

In the "flats" and sheltered hollows among the "shifting" dunes the following species occur:—

DOMINANT SPECIES.

Ammophila arenaria, Link.

ABUNDANT SPECIES.

<i>Erodium cicutarium</i> ,	<i>Euphorbia Paralias</i> , Linn.
L'Hérit.	<i>Euphorbia portlandica</i> ,
<i>Anaphalis margaritacea</i> , B.	Linn.
& H. fil.	<i>Iris foetidissima</i> , Linn.
<i>Senecio Jacobæa</i> , Linn.	<i>Carex arenaria</i> , Linn.
<i>Oniscus arvensis</i> , Hoffm.	

FREQUENT OR OCCASIONAL SPECIES.

<i>Erigeron acre</i> , Linn.	<i>Cynoglossum officinale</i> , Linn.
<i>Taraxacum erythrospermum</i> , Andrz.	<i>Verbascum Thapsus</i> , Linn.
	<i>Verbena officinalis</i> , Linn.

The variety *glandulosum*, Bosch., of *Erodium cicutarium* has been recorded from this district. *Anaphalis margaritacea* is well established on the dunes, and apparently succeeds best where competition is reduced to a minimum. *Cnicus arvensis* colonises the sandy hollows towards the inner limit of the mobile dunes. It is also abundant on the fixed dunes, as in Norfolk. *Euphorbia portlandica* is absent from the Somerset sand hills.

Salix repens Association.

As already mentioned, this association includes within its limits plants of the mobile dunes, as well as those of the fixed dunes. The following species occur:—

DOMINANT SPECIES.

Salix repens, Linn.

SUBDOMINANT SPECIES.

Rubus cespitosus, Linn.

Ammophila arenaria, Linn.

FREQUENT SPECIES.

Viola ericetorum, Schrad.

Leontodon (*nudicaule*), B.
& S.

Viola Curtisii, Forster.

Erodium cicutarium,

Euphorbia Paralias, Linn.

L'Hérit.

Iris foetidissima, Linn.

Rosa spinosissima, Linn.

Carex arenaria, Linn.

Erigeron acris, Linn.

Phleum arenarium, Linn.

Cnicus arvensis, Hoffm.

Viola Curtisii was recorded from the sand dunes near Aberavon, over sixty years ago. It is not found in Somerset. The damp sandy hollows which occur within the limits of the *Salix* association possess a characteristic vegetation. These depressions lie at a low level, and during the winter months are frequently submerged. A layer of humus is formed in places, and in conjunction with an increased water content produce a plant society of a definite type. The *Salix* forms a fringe round the margin of these hollows, which are colonised by the following species:—

<i>Samolus Valerandi</i> , Linn.	<i>Littorella uniflora</i> , Aschers.
<i>Erigeron canadense</i> , Linn.	<i>Helleborine longifolia</i> , R.
<i>Hydrocotyle vulgaris</i> , Linn.	& B.
<i>Anagallis tenella</i> , Murr.	<i>Orchis incarnata</i> , Linn.
<i>Blackstonia perfoliata</i> , Huds.	<i>Juncus effusus</i> , Linn.
<i>Mentha aquatica</i> , var. <i>hirsuta</i> (Huds.).	<i>Equisetum palustre</i> , Linn.

The occurrence of these species in the different hollows depends upon the relative amount of moisture present. Practically pure societies of one particular species are not uncommon.

Kenfig Pool is situated within the limits of the *Salix* association, and its general features have already been described. On its sandy margin the vegetation met with is mainly that of the damp hollows. A sheltered bay on its landward side is rich in species, and the vegetation here and there is of the marsh type. On the opposite shore, which is exposed to frequent sand-blasts from the adjoining dunes, very few plants occur. Space does not permit of a detailed description of the flora and its distribution, but the following list of commoner species will suffice to indicate its character and composition:—

<i>Ranunculus peltatus</i> , Schrank.	<i>Polygonum amphibium</i> , Linn.
<i>Custalia alba</i> , Wood.	<i>Rumex Hydrolapathum</i> , Huds.
<i>Hydrocotyle vulgaris</i> , Linn.	
<i>Menyanthes trifoliata</i> , Linn.	<i>Iris foetidissima</i> , Linn.
<i>Scutellaria galericulata</i> , Linn.	<i>Alisma ranunculoides</i> , Linn.
<i>Scutellaria minor</i> , Huds.	<i>Eleocharis palustris</i> , R. & S.
<i>Littorella uniflora</i> , Aschers.	<i>Carex leporina</i> , Linn.
	<i>Carex Goodenowii</i> , Gay.

Limosella aquatica, var. *tenuifolia*, Lej., was recorded as occurring in great quantities on the sandy shores of the pool in 1898, but it has not been observed in this locality since 1908. Trees are practically absent from the mobile dunes. On the northern limit of the fixed dunes sand plantations occur, while the alder grows freely on the banks of Kenfig river, and follows its course for a considerable distance on the alluvium. Stunted, wind-pruned specimens of *Sambucus nigra* are met with here and there

on the "shifting" dunes, usually in somewhat exposed situations. *Hippophaë rhamnoides*, which forms a dense scrub on the Norfolk dunes, and is also reported by Moss as frequent on the Somerset sand hills, does not occur.

Vegetation of the Fixed Dunes.

The transition from the associations of the "mobile" dunes to those of the "fixed" dunes is gradual. Fixation by *Salix*, *Rubus*, and sward-forming plants, like *Festuca rubra*, begins in the more sheltered hollows, near the inner limit of the shifting dunes. In the more exposed stations the Marram grass still holds its own, and on the dune grassland, where *Pteris* is absent, it remains a dominant type. Where dune grassland gives place to cultivated land, bush vegetation and trees form a final barrier to the invasion of the sand.

Pteris aquilina Association.

In the more open stations of this association the following species occur, in addition to many of those already mentioned :—

<i>Erophila verna</i> , E. Meyer.	<i>Saxifraga tridactylites</i> , Linn.
<i>Cerastium semidecandrum</i> , Linn.	<i>Carlus nutans</i> , Linn.
<i>Cerastium tetrandrum</i> , Curt.	<i>Sedum acre</i> , Linn.
<i>Stellaria apetala</i> , Ucria.	<i>Lycopsis arvensis</i> , Linn.
<i>Sagina nodosa</i> , Frenzl.	<i>Myosotis collina</i> , Höfm.
<i>Vicia angustifolia</i> , Linn.	<i>Koeleria gracilis</i> , Pers.
	<i>Festuca rubra</i> , Linn. and its different maritime forms.

On those fixed dunes, from which *Pteris* is absent, *Ammophila* is almost a dominant type, and the association is a closed one. Many of the included plants are those of cultivated land. In addition to some of the species already mentioned as occurring in the bracken association, the following are abundantly represented :—

<i>Geranium molle</i> , Linn.	<i>Leontodon nudicaule</i> , B. & S.
<i>Galium saxatile</i> , Linn.	<i>Rumex Acetosella</i> , Linn.
<i>Bellis perennis</i> , Linn.	<i>Urtica dioica</i> , Linn.
<i>Cnicus lanceolatus</i> , Willd.	<i>Luzula campestris</i> , DC.
<i>Cnicus arvensis</i> , Hoffm.	

On the innermost margin of these fixed dunes *Ulex europæus* is occasionally met with. Mosses and lichens are common here, and in the transitional associations. They play an important part in preparing the ground for the growth of flowering plants. Here and there on these fixed dunes limited areas have been enclosed and are now under cultivation. It is impossible at this preliminary stage in the study of the vegetation of this formation to form any opinions on its composition and distribution which will be of lasting value. The particular area which forms the subject of this communication is too restricted in extent, in any case, for generalised deductions. The mere listing of species included in the different associations is but the initial stage in any ecological study. Were these lists complete, much would yet remain to be done. Critical forms must be made the subjects of careful investigation. A thorough investigation of the dependent species and their habit of life must be undertaken, to determine the relationship existing between them and the dominant type, in the association in which they occur.

The powers of adaptation and adjustment to environment of the individual plants, and many other kindred problems, still await solution.

NOTE ON ARGANIA SIDEROXYLON, ROEM. ET SCHULT., THE
ARGAN TREE OF MOROCCO. By SYMINGTON GRIEVE.

Morocco, although so near to our shores, is less explored than almost any part of the world. Large areas of the country, especially along the line of the Great Atlas range, with stretches upon each side of these mountains, are quite unknown. It is from these mountain fortresses that have come those hordes of wild men who know no other law than that "might is right."

To judge from the merchandise brought to the coast towns, the country seems to be productive. Under good and firm administration its resources may perhaps be developed in a way that will surprise Europe. The impression formed from what we saw at Casa Blanca and elsewhere was that the French had come to stay. Recent events have shown that we were not wrong in our anti-

cipations. No nation builds cantonments for its soldiers, and erects great walled caravanseries outside the gates of the coast cities to protect the merchants, their merchandise, camels, mules, and donkeys, from brigands, unless it anticipates being able to occupy the country permanently.

It is in Southern Morocco that the only forest of *Argania Sideroxylon* is known. It grows upon the arid plains and lower spurs of the foothills of the great Atlas range, stretching from the river Tansift on the north, southwards past the walled city of Mogodor, to near Agadir, where the Germans recently anchored their warships. The Argan forests are confined to the two provinces of Haha and Shiadhma. The forest is quite natural and not cultivated in any way, and you may ride for miles and miles among these trees. At a short distance the traveller might think he was approaching a forest of olive trees, but a little nearer the illusion is dispelled, as the leaf is different and the fruit larger. The trees are wide-spreading, thorny, and most grow to a height of from 15 to 25 feet. One of these trees is mentioned in Hooker's *Journal of Botany* for 1854 (vol. vi. p. 97), which measured not more than 18 feet in height, while its outer branches spread so as to give a circumference of 220 feet. Some are apparently of great age, with gnarled stems and branches, into which goats climb, as they, as well as camels, cows, and sheep, are very fond of the fleshy pericarp. It forms for these animals a valuable food, but is of no value otherwise. The ripe fruits contain a stone which, when broken, is seen to contain a kernel, and these kernels are of great commercial value.

Budgett Meakin, *Land of the Moors*, p. 42, says:—

“The nuts having been cracked between stones by the natives, the kernels are roasted, pounded, and kneaded by hand, first with the addition of a little hot water, then with cold. The oil is then expressed, and the residuary cake is given to cows and goats, as horses and camels refuse it. Argan oil is really good, but suffers like that of the olive from the primitive process employed. It is necessary to clarify it and to burn off impurities before use, unless one is hardened to its acrid taste and pungent smoke. This is accomplished by boiling the oil with a sliced onion and, when hot, dropping in a piece of crumb

bread which is allowed to char and is then thrown away. Both oils are used for burning in native lamps."

From the size of the trees it may be gleaned that they do not yield any really large timber, but some of the trees have short, thick stems; the wood is hard, fine-grained, and yellow in colour.

The Mbors very much prefer Argan oil to Olive oil for culinary purposes. They have, however, a strange belief that in some way its use predisposes to leprosy. Leo Africanus, who wrote about 1526, mentions this. As a specific for leprosy it is recommended to use a decoction of Argan leaves, both internally and externally.

G. G. Colaço, Portuguese Consul at Laraiche in 1818, was convinced that copious draughts of this oil were a cure for the bubonic plague. This plague, known as the "black death," had raged in Morocco just prior to that time, and he was so sure of the efficacy of the treatment that he had circulars printed in Arabic to enlighten the people and persuade them to use the remedy.

It is said that attempts have been made to grow this tree in different countries with climates that seemed suitable. Some of these trials were at first attended with prospects of success, but ere long turned out entire failures.

I obtained some of the fruits when in Morocco, and an attempt is now being made to grow trees from some of them at the Royal Botanic Garden.¹ The fruit is, when ripe or approaching ripeness, pale yellow, but, as it ripens further, becomes darker in colour, and old fruits are nearly black.

The principal outlet for the trade of the Sahara, Tafilat, Marakesh, or Morocco city, the southern portion of the Great Atlas range, and the district of the Sus, is by the trade routes converging upon the city of Mogodor. The present city, with its imposing walls and gateways, was built in 1760 by Sidi Mohammed XVII. This town is well laid out from the plans of a French engineer named Cornuc. There is a good water supply, which is conveyed by an overground closed conduit from a fine spring near Diabát to a large stone tank beneath the sand hills. Even in recent times this city has had exciting experiences. On

¹ Young plants grown from the above fruits are now (May 1913) about 15 to 18 inches high, and are all in a healthy condition.

13th August 1844 it was bombarded by the French under the Prince de Joinville. After the bombardment the neighbouring tribes sacked the city, massacring the inhabitants. A short time after, when the war with the French was ended, a messenger was sent by the Sultan to tell the inhabitants of the conclusion of peace. When he arrived there was not a soul left in Mogodor to whom he could deliver the message. In 1873 the tribesmen besieged the city closely, cut off the water supply, and destroyed the gardens. These proceedings had a most serious effect upon the besiegers, who could not storm the walls as they had no cannon, could not continue the siege without food, and so they had to retire.

It is to Mogodor that almost all the Argan oil comes that is sold, but I understand that at present there is such a good home demand that very little leaves the country.

THE SCOTTISH ALPINE BOTANICAL CLUB EXCURSION, 1911.
By ALEXANDER COWAN.

Owing to the visit to Edinburgh of His Majesty the King and the postponement of the Highland Show to the last week of July, it was decided to meet this year at Barnstaple, in Devonshire, in the first week of August, as several members of the Club had made arrangements to attend the annual meeting of the British Pteridological Society held there at the same date.

Although several members had expressed their intention of joining the excursion, most of them were prevented at the last moment from going, and the party which left Edinburgh on Tuesday, 1st August, consisted of only the President, the Chaplain, and the Secretary. As a night had to be spent somewhere on the way to Barnstaple, it was decided to stay at Bristol in order that a visit might be paid the following morning to the Clifton Zoological Gardens, where the members were most kindly shown round by Mr. Harris, the curator. Here a large quantity of very fine specimen trees are to be seen, as well as a collection of over a hundred varieties of Holly, and the late Colonel Jones' extensive collection of British Ferns, in which the varieties of *Polystichum angulare* and

Scolopendrium vulgare were specially noteworthy for their magnificent growth and development, some remarkably fine varieties of the latter fern being seen.

After leaving the Gardens, in which a large collection of animals and birds is kept, the members walked along a part of Clifton Downs to the Suspension Bridge, and within two or three hundred yards of the bridge, where the formation is limestone, the following interesting plants were found:—

Clematis Vitulba, Linn.; *Poterium Sanguisorba*, Linn.; *Sedum acre*, Linn.; *Foeniculum vulgare*, Mill.; *Galium verum*, Linn.; *Scabiosa Columbaria*, Linn.; *Carduus acaulis*, Linn.; *Crepis virens*, Linn.; *Orobanche Hederae*, Duby; *Verbena officinalis*, Linn.; *Salvia Verbenaca*, Linn.; *Parietaria officinalis*, Linn.; *Asplenium Rutamuraria*, Linn.

In the afternoon the journey was continued to Barnstaple, which was reached about six o'clock, and the Red Lion Hotel was made the headquarters of the party.

On the morning of 3rd August the members went by railway on the Ilfracombe line to Braunton, and from there drove about three miles west in order to visit Braunton Burrows, which is the name given to a large tract of sand dunes lying close to the sea, and where a large number of very interesting plants were found, many of them new to the members, and several in large quantities. Though the whole day was spent here, only a small portion of the Burrows was explored. On the way from the Burrows back to Braunton Station the party saw quantities of *Scolopendrium vulgare* and *Polystichum* growing in the banks at the sides of the lanes. The following plants were found:—

Reseda Luteola, Linn.; *Viola Curtisii*, E. Forst.; *Saponaria officinalis*, Linn.; *Hypericum quadrangulum*, Linn.; *H. perforatum*, Linn.; *Melilotus officinalis*, Lam.; *Trifolium fragiferum*, Linn.; *Agrimonia Eupatoria*, Linn.; *Cotyledon Umbilicus-Veneris*, Linn.; *Peplis Portula*, Linn.; *Lythrum Salicaria*, Linn.; *Apium nodiflorum*, H. G. Reichb.; *Sium erectum*, Huds.; *Oenanthe fistulosa*, Linn.; *Sambucus nigra*, Linn.; *Dipsacus fullonum*, Linn.; *Eupatorium cannabinum*, Linn.; *Erigeron acris*, Linn.;

Inula squarrosa, Bernh.; *Pulicaria dysenterica*, S. F. Gray; *P. prostrata*, Aschers.; *Senecio erucifolius*, Linn.; *Carlina vulgaris*, Linn.; *Centaurea Scabiosa*, Linn.; *Cichorium Intybus*, Linn.; *Anagallis arvensis*, Linn.; *A. tenella*, Murray; *Samolus Valerandi*, Linn.; *Ligustrum vulgare*, Linn.; *Blackstonia perfoliata*, Huds.; *Centaureum umbellatum*, Gilib.; *Lithospermum officinale*, Linn.; *L. arvense*, Linn.; *Solanum Dulcamara*, Linn.; *Hyoscyamus niger*, Linn.; *Verbascum Thapsus*, Linn.; *Sibthorpia europæa*, Linn.; *Rhinanthus Christa-galli*, Linn.; *Marrubium vulgare*, Linn.; *Teucrium Scordium*, Linn.; *Salsola Kali*, Linn.; *Euphorbia Parulias*, Linn.; *E. portlandica*, Linn.; *Populus alba*, Linn.; *Helleborine palustris*, Schrank.; *Orchis latifolia*, Linn.; *Iris foetidissima*, Linn.; *Juncus maritimus*, Lam.; *J. acutus*, Linn.; *Typha latifolia*, Linn.; *Alisma Plantago-aquatica*, Linn.; *Scirpus maritimus*, Linn.; *S. Holoschoenus*, Linn.; *Carex hirta*, Linn.; *C. binervis*, Sm.; *C. vulpina*, Linn.; *C. disticha*, Huds.

On 4th August the party, together with several members of the Pteridological Society, decided to travel by the narrow-gauge railway towards Lynton in order to visit Woody Bay, which is reached, after leaving the train, by a road passing across about two miles of moor, where, among the heather, were growing large quantities of a dwarf *Ulex* in fine flower, the colour effect of this and the purple of the heather, *Erica cinerea*, being most striking.

At Woody Bay the banks slope down to the sea, a distance of five or six hundred feet at a steep angle, and are well wooded; hence the name. The scenery, which was most picturesque and wild, was much admired, and the day was very fine and warm. Large quantities of *Athyrium Filix-foemina*, *Blechnum*, *Lastrea*, and *Polystichum angulare* were seen; also *Scolopendrium vulgare* in great luxuriance on shady banks and walls. Though no variety of special note was found, a very good undulate variety of *Scolopendrium* and two plants of *Athyrium Filix-foemina* variety, *medio-deficiens* were found. The following plants were also found:—

Hypericum Androsaemum, Linn.; *Ulex Galli*, Planch.; *Ulex minor*, Roth.; *Crithmum maritimum*, Linn.; *Sambucus Ebulus*, Linn.

The members walked from Woody Bay east to Lynton, and returned to Barnstaple by train.

On the morning of 5th August the left bank of the River Taw at Barnstaple was visited. Here, on the tidal reach, were found:—

Apium graveolens, Linn.; *Aethusa Cynapium*, Linn.; *Caucalis Anthriscus*, Huds.; *Inula squarrosa*, Bernh.; *Artemisia vulgaris*, Linn.; *A. maritima*, Linn.; *Mentha rubra*, Sm.; *Scirpus maritimus*, Linn.; *Carex distans*, Linn.; *Lepturus filiformis*, Trin.

In the afternoon a visit was paid to South Molton, on the railway towards Taunton, where *Asplenium Adiantum-nigrum*, with variegated foliage, was found by the President. The following plants were also found:—

Hypericum Androsaemum, Linn.; *Circaea lutetiana*, Linn.; *Chaerophyllum temulum*, Linn.; *Caucalis Anthriscus*, Huds.; *Centaureium umbellatum*, Gilib.; *Satureia Calamintha*, Scheele; *Scutellaria galericulata*, Linn.; *Helleborine latifolia*, Druce; *Tamus communis*, Linn.; *Bromus ramosus*, Huds.; *Blechnum Spicant*, With.; *Scolopendrium vulgare*, Sm.; *Asplenium Adiantum-nigrum*, Linn.; *Polystichum angulare*, Presl; *Dryopteris aristata* (Vill.).

On Monday, 7th August, the members went by train to Fremington, on the Bideford line, lying on the estuary of the River Taw, about three miles from Barnstaple. Considerable time was spent on the shores of the estuary and in the marshy meadows alongside, in one of which *Carex extensa* and *Statice Limonium* were growing in great quantity, the latter being in full flower, and the following plants were found:—

Ranunculus sceleratus, Linn.; *Cakile maritima*, Scop.; *Tamarix gallica*, Linn.; *Apium graveolens*, Linn.; *Curum Petroselinum* Benth. et Hook.; *C. segetum*, Benth. et Hook.; *Aster Tripolium*, Linn.; *Senecio squalidus*, Linn.; *Statice Limonium*, Linn.; *Lycopus europaeus*, Linn.; *Scutellaria galericulata*, Linn.; *Beta maritima*, Linn.; *Atriplex laciniata*, Linn.; *A. Portulacoides*, Linn.; *Salicornia europaea*, Linn.; *Typha latifolia*, Linn.; *Sparganium ramosum*, Huds.; *Scirpus maritimus*, Linn.; *S. lacustris*, Linn.; *Carex extensa*, Good.; *C. remota*, Linn.; *C. vulpina*, Linn.

The members had to leave early in the afternoon in order to begin their journey homewards. Owing to its being Bank Holiday, the trains were all very late, and the crowds enormous, so that the return journey, as far as Bristol, was begun under most uncomfortable circumstances.

SHORT NOTES.

Barbula gracilis Schwaeg. New to Scotland.—In October last year I gathered in Glen Phee, Clova, *Barbula gracilis* Schwaeg. This moss, although unrecorded for Scotland, is probably often overlooked owing to its resemblance to *Barbula fallax*. It is rather interesting to note that it grows on the same rock faces of quartzose gneiss as *Oxytropis campestris* and *Selania casia*. The moss, as is always the case in Britain, was sterile. Specimens were sent to Mr. D. A. Jones, Harlech.

MARGARET CORSTORPHINE.

Centunculus minimus, L., in Wigtownshire.—In August last I found this plant growing in small quantity on Craigoeh Moor on the footpath on the top of the cliffs approaching Morroch Bay from Portpatrick; a new record for vice-county 74.

JAMES FRASER.

The following are a few new records for Scottish vice-counties:—

Silene fimbriata, Sims, from the south bank of the Crinan Canal, Argyllshire, at Auchendarroch Lodge: evidently an outcast.

Piptatherum multiflorum, Beauv., from near Musselburgh, the first record of this grass from Britain.

Epilobium nummularifolium, R. Cunn., in plenty on garden walls at Ardrishaig, Argyllshire: an escape.

Juncus tenuis, Willd., west of West Linton, Peeblesshire.

JAMES M'ANDREW.

Potamogeton prelongus, Wulf., in Orkney. In September 1911 Mr. M. Spence of Durness sent me a specimen of the above species from a loch where it grew with *P. perfoliatus*, L., and *P. filiformis*, Nolte.

It occurs in Shetland!, Caithness!, and Sutherland!. It is also a Faroeen species, but is not included in Stefansson's "Flora Islands," 1901.

It is not recorded from Greenland, but occurs at 70° N. lat. at the mouth of the Yenisei (Scheutz., 1888), and nearly as far north in Norway, Alten, 69° 56' (Norman).

ARTHUR BENNETT.

Juncus alpinus, Vill., in Kirkcudbright. Mr. G. West records¹ this species from the drier parts of some of the sandy bays of Loch Grennoch by Cairnsmore of Fleet.

It is there associated with "a dwarf form of *Scirpus palustris* about 4 inches high, with short, stout, very scaly rhizomes and few flowering stems."

This loch "is a fine sheet of water 2 miles long by $\frac{3}{4}$ mile wide, at an elevation of 690 feet above sea-level."

This makes eleven Scottish vice-counties in which this species is recorded, and it will eventually, I think, be found in others, especially in Orkney and the Outer Hebrides.

I quite expect to hear of its occurrence in England on the north-west coast, where *Sagina nodosa*, L., var. *muniliformis*, Meyer,² was detected this year by Dr. Graebner, and specimens of which Mr. Travis has kindly sent me. This variety occurs on the Friesien Islands, and Bornholm in Denmark, where it grows associated with *Juncus alpinus*.

The *Juncus* is on record for Glamorgan (Dr. Vachell sp.) only, outside Scotland, in the British Isles.

Dr. Buchenau combines under *alpinus*: *J. alpestris*, Hartm.; *J. atratus*, Fries; *J. fusco-ater*, Schreb.; *J. ustulatus*, Hoppe; and *J. nodulosus*, Whlbg.

ARTHUR BENNETT.

Philonotis rigida, Brid.—Mr. James M'Andrew made an interesting addition to the Perthshire list of mosses last May, when he collected a specimen of *Philonotis rigida*, Brid., at Aberfoyle (v.c. 87). The determination was con-

¹ "Cont. Comp. Study of Dominant Phanerogamic, etc., Flora of Aquatic Habit in Scottish Lakes," in Proc. Roy. Soc. of Edin., xxx. (1910), p. 113.

² "Hann. Magazine," 1824, p. 169.

firmed by Mr. H. N. Dixon. This species is not entered in the Census Catalogue for any of the Scottish counties, although it has been reported from Orkney at least, if not from elsewhere in Scotland. As, however, it is mainly a southern species it was thought safer, in the absence of specimens, to omit the record. R. H. MELDRUM.

Cornus suecica, Linn., in Peeblesshire (v.c. 78).—I am glad to be able to record this species from Peeblesshire. On 10th June 1911 my brother, Mr. W. T. Blackwood, drew my attention to a small patch on the Dollar Law containing about a dozen flowering heads. The area covered was very limited, but later in the day another small patch was found.

So far as I am aware, this plant is at present recorded from Scottish vice-counties 112, 108, 107, 106, 105, 98, 97, 96, 94, 92, 90, 89, and 88.

South of Perth and Forfar it has not been noted except from 62 York n. east, and 68 Cheviotland. In "Topographical Botany" Watson, however, gives, "83 Edinburgh by a trick?" but in the appendix to both the first and second editions of Lightfoot's "Flora Scotica" it is recorded from the Pentlands on the authority of Dr. Hope. It would be more satisfactory if this old record were confirmed, as it probably can be.

The Peeblesshire record is interesting as being a connecting link between the English and the other Scottish stations. G. G. BLACKWOOD.

Zostera nana, Roth., in Aberlady Bay, Haddingtonshire (v.c. 82), etc.—With reference to the extract from the Report of the Botanical Exchange Club for 1910, given in the "Scottish Botanical Review" (p. 53), I have to point out that I recorded *Zostera nana* from Aberlady Bay so long ago as 1889 in the "Transactions of the Botanical Society of Edinburgh" (vol. xvii. p. 415). In my note, which is entitled, "On the Occurrence of *Zostera nana*, Roth., in the Firth of Forth," I also recorded the plant from the mud flats west of Cramond (v.c. 84), and near Torryburn (v.c. 85). These records apparently escaped Professor

Trail's notice when he drew up his "Topographical Botany of the River-Basins of Forth and Tweed" (Trans. Bot. Soc. Edin., 1903).

WILLIAM EVANS.

Petasites albus, Gaertn., in Fife.—A specimen of this plant was brought to me in February; it was found growing near a burn in the Chapel district, and was first noticed in flower at the beginning of February. This species seems to be spreading in Scotland, and is well established in several places in the counties of Edinburgh and Linlithgow. I am not aware of it having been recorded before for this side of the Forth.

N. MILLER JOHNSON.

Note on some vice-county records of *Cornus suecica*, Linn., etc.—To the list of Scottish vice-counties from which *Cornus suecica* has been recorded, given by Mr. G. G. Blackwood (p. 97), must be added 87 (So. Perth) and 111 (Orkney). In the former it has long been known to grow sparingly on Ben Ledi, where it was gathered by Professor J. H. Balfour and party on 21st July 1860, and in subsequent years, as recorded in his "Botanical Excursions," pp. 309, etc. I have before me a specimen collected there so recently as July 1907. The Orkney record—from the island of Hoy—is given by Mr. Arthur Bennett in "Ann. Scot. Nat. Hist.," 1908, p. 251. To the English vice-counties should be added 59 So. Lancashire (*id.*, *ibid.*, 1911, p. 190).

WILLIAM EVANS.

Saxifraga aizoides, L.—Among plants from Orkney sent by Mr. M. Spence are two specimens of the above Saxifrage, and answering to the description of the *f. aurantia* of Hartmann, "Vet. Ak. Handl.," 1818. The leaves are orange, shading to yellow at the apex. The lower stem leaves are suffused with red, and the fruit is orange-red (only half-ripe). The leaves are quite entire, very thick, with here and there a long patent hair. This form occurs in Norway, with the ordinary form in Sweden, and rarely in Russian and Finnish Lapland. Is not the figure in "English Botany," t. 59, quite a rare form? I

have not seen such stem leaves on any specimen as there represented, and the description says "rarely denticulate."

A. BENNETT.

Utricularia vulgaris, L., in Caithness.—Good specimens of the above (though not in flower) have been sent me by Miss I. Lillie and Mr. G. Lillie from Loch Watten on the east coast of Caithness. There are several of the winter buds; these are strongly setose, with translucent, spinose-like hairs, and the young leaves are spinose-setose. The young bladders are semi-transparent, the older ones also, but with the addition of a yellowish nucleus. This definitely records the species for the county.

A. BENNETT.

Cnicus oleraceus, Linn. = *Cirsium oleraceum*, Scop.—This plant has occurred this season on a marshy meadow by the side of the Tay, left bank, about a mile below Perth. It forms a small patch comprising about sixty or seventy flowering shoots, and was certainly not there, at least in the flowering stage, till this season. How it came I am unable to conjecture, as it is certainly not a plant likely to be cultivated, and the meadow, though cut, consists of natural herbage only, and is never sown. Mr. Arthur Bennett informs me that it occurred in Lincolnshire from 1832 to 1840 on the Fen banks, and I believe it has been found in Scotland amongst other casuals. The plant was named for me at the Herbarium of the Royal Botanic Garden, Edinburgh. It has yellow flowers. Near to the same place a little patch of *Sanguisorba canadensis*, Linn., has kept its place amongst some alder bushes for more than half a century. Till this year I have never seen any signs of its spreading. But this summer at least three other patches, at about a hundred yards further down and clear of the bushes, have made their appearance and have flowered freely. One patch in the middle of the meadow forms a circle of a good many yards in diameter and comprises a considerable number of plants. Possibly the very hot summer of last year may have more thoroughly ripened the seeds and thus enabled the plant to extend its area.

Juncus tenuis, Linn.—In going through Glen Ogle in

July this sedge occurred in great plenty by the roadside about half-way between Lix and the summit of the pass. For about a quarter of a mile it formed a close band along the left side of the road. For about another half mile I traced it in patches and isolated plants. It seemed as if carts loaded with American fodder had been passing along the road dropping seeds at first thickly and then more thinly. Certainly the plant is not native in any of the Perthshire stations in which it has been found.

W. BARCLAY.



PARISH OF SHOTS. (Scale $\frac{1}{2}$ inch to 1 mile.)
 from the Ordnance Survey Map with the sanction of the Controller of H. M. Stationary Office.

TRANSACTIONS
OF THE
BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXVII.

SURVEY OF THE VEGETATION OF THE PARISH OF SHOTTS,
LANARKSHIRE. By GEORGE BROWN, M.A. (Plate IV.)

Introduction.

The following survey of the vegetation of the parish of Shotts was begun in July 1908, and has been continued at vacation times during the past four years. It is an attempt, not to give exhaustive lists of the plants of the area, but to study the various plant associations and their relation to the topographical, geological, and climatic characteristics of the district.

For much help in connection with the finding and naming of certain of the plants I am greatly indebted to my old schoolmaster and friend, Mr. Dunn, Schoolhouse, Harthill. The various agricultural statistics were kindly supplied by the Board of Agriculture.

Topography.

Shotts Parish is in the north-east of the Middle Ward of Lanarkshire. It is bounded on the N.W. and N. by the parish of New Monkland, being separated therefrom by the North Calder Water; on the N.E. and E. by the parishes of Torphichen, Bathgate, and Whitburn, in Linlithgowshire, separated from these by Barbauchlaw Burn and How Burn; on the S.E. and S. by the parish of Cambus-

nethan; and on the S.W. and W. by the parishes of Dalziel and Bothwell, the natural boundaries being the South Calder Water, Tillan Burn, and Shotts Burn.

It has an area of about thirty-nine square miles (24,835 acres). Its greatest length—from the point on South Calder Water, where the parishes of Shotts, Cambusnethan, and Dalziel meet to the boundary line beyond Southrigg—is about eleven miles; its greatest breadth—from Shotts Iron Works, on the South Calder Water, to North Calder Water—being about seven miles.

The surface consists to a large extent of undulating ridges¹ varying in height from 700 to 900 feet. The altitude ranges from 340 feet on the Shotts Burn to nearly 1000 feet on the Cant Hills, which form part of the ridge that is the water-parting of the basins of the Clyde and the Forth.

The chief streams, besides those mentioned under boundaries, are the River Almond and Forrestburn Water. The former rises within the parish and flows towards the east; the latter flows east into Forrestburn Reservoir, the overflow continuing to join Barbauchlaw Burn.

The main water areas are: Hillend Reservoir, on the northern border, which supplies the Forth and Clyde Canal—of its area (300 acres) only 172 acres are in the parish; Lilly Loch, lying a little to the south of this and being a compensation reservoir for the same canal—the loch previous to its being altered for this purpose had water-lilies growing in it; Forrestburn Reservoir, being the water supply for Linlithgowshire; Roughrigg Reservoir, farther to the west, supplying the Airdrie and Coatbridge district.

Geology and Soil.

The district consists entirely of Carboniferous rocks overlaid by glacial drift or boulder clay which varies both in composition and thickness in different parts. In some places there are present in the clay sandstone and gravel, but generally boulders of volcanic origin. The most notable

¹ Cf. the following place and farm names: Northrigg, Southrigg, Hillhouse-ridge, Westcraigs, Craighead, Knowehead, Roundknowe, Blairmuckhill, Bridgehill, Dewshills, Brownhill, Drumfin (=“the fair ridge”), Drumbowie (=“the yellow ridge”), etc.

feature of the geological structure is the intrusion of a number of quartz-dolerite sills in the northern region of the parish, these being prominent features of the landscape. The dolerite varies much in structure, from a fine-grained rock to one of a more coarsely granitic structure.

There is much variation in the soil—from a stiff, almost unworkable clay to a more easily worked and lighter sandy or gravelly soil, sometimes mixed with peat earth.

Peat covers large areas, making bleak the district where it is dominant. In places it rests on glacial drift and in others on the dolerite bosses. But where the rock crops out, and where the coating of soil is consequently thin, there is often an absence of peat, a feature which is no doubt accounted for by the chemical composition of the dolerite.¹

Region of Cultivation.

Of the total area of the parish something like 14,000 acres are arable. It is a region which may be characterised as "without wheat cultivation," there being only 2½ acres of wheat according to the latest returns. Oats are cultivated all over, almost to the highest point of the parish.

The following statistics from the Board of Agriculture (see next page) give the chief subdivisions of the cultivated area and the comparison of these divisions for the years 1867 (the year in which returns were first collected on a basis similar to that of the subsequent years), 1902, and 1912.

One noticeable feature is the increase in permanent grass, the returns for 1912 being 3082 acres and 244 acres more than those for 1867 and 1902 respectively. There is a decrease in the acreage under cereals as compared with 1867, and an increase as compared with 1902.

Both with regard to position and to the character of the soil oats cultivation is favoured. Owing to the altitude, the unsheltered position of the land, and the amount of rainfall, the parish does not lend itself to wheat raising. In many places the country-side is bleak, the westerly winds sweeping across it unhindered by mountain or hill.

¹ Cf. C. B. Crampton, "Stable and Migratory Plant Formations" ("Scot. Bot. Review," vol. i., No. 2).

*Acreage under Crops and Grasses in the Parish
of Shotts, County of Lanarkshire.*

Crop.		1867.*	1902.	1912.
Corn Crops.	Wheat	10	29½	2½
	Barley or Bere	25	11½	20½
	Oats	1869	1556	1844½
	Rye	25	...	...
	Beans and Peas	28	7½	...
Totals		1957	1604½	1867½
Green Crops.	Potatoes	112	63½	51½
	Turnips and Swedes	279	292½	306
	Cabbage, K.-Rabi, Rape	22	35½ (Including Mangold ½)	85
	Vetches or Tares . . . . .	..	...	12½
Totals		413	392	454½
Clover, Sainfoin and Grasses under Rotation		2526	3429½	2611½
Permanent Grass		5263	8101	8345
Other Crops		70	27½	11½
Bare Fallow		144	½	26
Total Acreage under Crops and Grasses		10,373	13,549½	13,316½
Mountain and Heath Land used for Grazing		No return.	4531½	4980

* Board of Agriculture Note.—“Returns of the area under mountain and heath land used for grazing were not collected in 1867, and as the returns generally, especially the areas under grass, may not have been so accurate in the earlier years as at present, comparison over so long a period should only be made with caution.”

Rainfall statistics for the parish are not available, except for the district of Hillend Reservoir. But the following table, made up from “The Mean Annual Rainfall of Scotland,” 1871–1910, by A. Watt, M.A., F.R.S.E., gives statistics

DIAGRAMS.

(From "Agricultural Returns," 1912.)

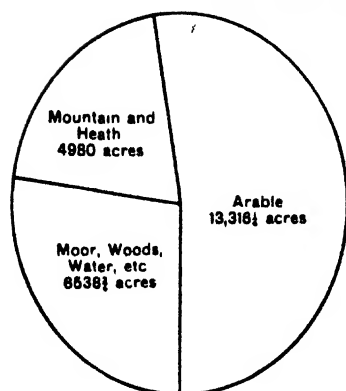


Fig. 1.—Proportionate Areas of Arable and Non-arable Lands.

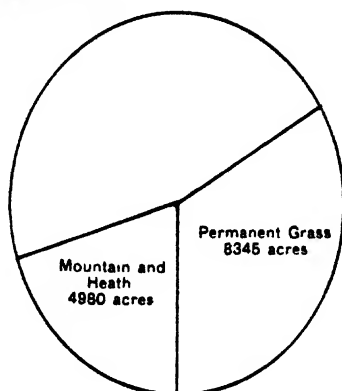


Fig. 2.—Proportionate Areas of Permanent Grass and Mountain and Heath Land.

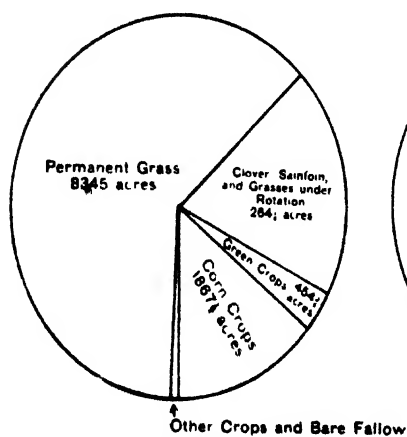


Fig. 3.—Proportionate Areas of Arable Land.

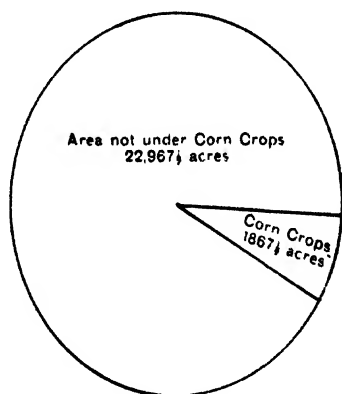


Fig. 4.—Proportionate Area under Corn Crops.

for rainfall for certain stations—just outside the boundaries—in Lanarkshire and Linlithgowshire, having heights similar to those within the parish:—

Stations.	Height above Sea.	Period.	No. of Years.	Mean Annual Rainfall.
<i>Lanarkshire—</i>				
Hillend Reservoir . . .	620 ft.	1871-1910	40	37·78 ins.
Roughrigg Reservoir . . .	661 „	1906-1910	5	38·61 „
Hamilton Waterworks . . .	436 „	1881-1910	30	35·48 „
<i>Linlithgowshire—</i>				
Polkemmet (Whitburn) . . .	600 „	1881-1900	20	43·64 „
Bathgate, Boghead . . .	500 „	1901-1910	10	39·16 „

The region lies within the area of mean annual rainfall of 30-40 inches.

The following table, made up from Dr. Buchan's paper, gives the statistics of the mean January, July, and annual temperatures for stations in Lanarkshire having altitudes similar to places within the parish:—

Stations.	Height above Sea.	Mean Temperatures.		
		January.	July.	Annual.
Lanark	630 ft.	36·2	56·7	45·4
Carnwath	693 „	36·0	56·3	45·1
Douglas Castle	783 „	35·8	56·0	44·9

In the "Statistical Account of Lanarkshire" (1841) is found the following account of the state of the land in the parish at that time:—"From one-half to two-thirds of the lands in the parish are arable; the remainder is uncultivated. At least one-half of the uncultivated land might be profitably improved. . . . There is a very marked contrast between the state of the parish as it now exists, and as it is represented in the last Statistical Account. A large portion of these lands which were then unreclaimed, and which are there spoken of as unimprovable, is now made tillage and bears astonishingly good crops." Parts of the

uncultivated land referred to in the later account have been, and are being, reclaimed and cultivated.

An interesting note on the early tillage of the region occurs in Dr. Grossart's History of the Parish: "A circumstance worth mentioning is that at the end of last century (eighteenth) farmhouses were more numerous on the high-lying central ridge (*i.e.* from Cant Hills across to Moffat Hills, the watershed of the Forth and the Clyde) than in the lower and more fertile parts. At the present day this is reversed. The cause is obvious: larger farms have been created out of the ruins of the smaller. . . . On the flat top of Paperthill Crags (865 feet above sea-level) are found the remains of old tillage, its age beyond the ken of the present generation. On the Cant Hills, the highest land in the parish, are to be seen the remains of a still more ancient tillage, pertaining to a long-forgotten era."¹

The character of the soil has already been dealt with under Geology. There are some good farms where satisfactory crops are raised; while there are other farms where, owing to the poverty of the soil, poor crops are harvested.

Woodland.

What natural woods exist are to be found along the banks of streams, as, for example, on the South Calder² Water, Shotts Burn, Forrestburn Water, and North Calder Water. The others, except in the case of some of the small birch formations, are of an artificial character, being plantations of mixed deciduous trees, with conifers often very numerous.

DECIDUOUS TREES.—The beech (*Fagus sylvatica*, Linn.) is predominant, but most of the trees attain no great size, many of them being of a restricted, contorted growth. The woods of beech are small and occur in the cultivated area, some of them running in a north and south direction, thus serving as shelter and protection to the cultivated

¹ "But what struck him (the traveller) most was the sight of huge yokes of oxen dragging the plough far up the steep hill-sides in almost inaccessible places; and on his asking why? he learnt that the farmer was obliged to till the dry, steep braes because the ground below was hopelessly swampy."—H. G. Graham, "Social Life of Scotland in the Eighteenth Century."

² Calder = "the wooded stream."

parts from the prevailing winds. In these woods the beech is often uprooted by storms, and examination of some of the root systems has revealed that the roots are oftentimes superficial, spreading out all round but not sending down strong anchorage into the soil.

The trees occurring in the mixed deciduous woods are : *Fraxinus excelsior*, Linn. (ash); *Quercus Robur*, Linn. (oak); *Ulmus montana*, Stokes (elm); *Pyrus Aucuparia*, Ehrh. (rowan); *Crataegus Oxyacantha*, Linn. (hawthorn); *Sambucus nigra*, Linn. (elder); *Corylus Avellana*, Linn. (hazel); *Prunus Padus*, Linn. (bird cherry); *Prunus spinosa*, Linn. (sloe); *Salix*, spp. (willows). Sycamore and horse-chestnut are also met with in the plantations.

BIRCH WOODS.—There is some extent of birch (*Betula*) in the districts of Fortisset, Hartwood, and Dykehead, and in the estate of Murdostoun. To the north-east, in the neighbourhood of Harthill, at a height of between 600 and 700 feet, there are three much-depleted woods of small extent. The farthest out, towards the east, consists of about two dozen stunted and contorted trees with some scores of old stumps. To the south-west of this there is another wood with many more trees and fewer stumps, and still farther to the south-west are traces of an old birch wood. These are probably the remains of what was originally a much greater extent of birch. No conifers seem to be present in any of these remnants. The trees are growing in peat of some depth—one of the characteristics of the birch being its adaptability to acidity of soil due to humus formation. Seedlings of both the birch itself and mountain ash are frequent in the birch woods generally. The herbaceous undergrowth is that of the adjoining heath, *Calluna* occupying much of the ground in the opener and drier woods.

CONIFEROUS WOODS.—The dominant tree is the Scots pine (*Pinus sylvestris*, Linn.). The most extensive development of the pine is to be found in the south-west of the parish, in the district of Fortisset, Dykehead, and Hartwood, and on the estate of Murdostoun; but such woods are to be found all over the district. Some of the plantations are old and have undergone, and are undergoing, decay, while others have but recently been planted. In

the region of Hirst¹ Hill there are the remains of such old woods, many of the trees still standing but decayed, while alongside there is a young plantation, many of the trees but recently planted. Plantations of healthy young conifers are found also on the north and south sides of Forrestburn Reservoir, around Fortisset, and in certain parts of the Murdostoun estate; on a heather moor west of Hartwood young conifers and birches have been planted a year or two ago. In the "Statistical Account of Lanarkshire" (1841), the following is recorded of the parish: "Formerly Scotch fir was planted to the exclusion of all other trees, but now spruce and larch are preferred, both of which thrive remarkably well." Spruce and larch are found intermingled with the pines both in the older and the younger plantations, but the pine is dominant.

The examination of a small wood of *Pinus sylvestris* (in December 1911) in the north-east of the parish revealed the fact that the trees were of from thirty to forty years' growth. Measurements taken from the surface of the covering of needles to the harder layers, gave depths of from 12 to 18 inches, the layers being composed of humus and peat—peat being present at the surface in the opener parts of the wood. Birches and willows are scattered throughout the pines. Owing to the density of shade the flora is extremely limited, the only plants found being in the opener spaces and in the clearings of the wood, the following being the chief:—*Potentilla Tormentilla*, Scop.; *Galium saxatile*, Linn.; *Scabiosa Succisa*, Linn.; *Cnicus palustris*, Willd. (in wet places); *Vaccinium Myrtillus*, Linn.; *Calluna vulgaris*, Hull (in isolated patches); *Rumex Acetosa*, Linn.; *Juncus*, spp. (in wet places); *Anthoxanthum odoratum*, Linn. (in patches); *Agrostis vulgaris*, With. (in patches); *Deschampsia flexuosa*, Trin. (in patches); *D. cespitosa*, Beauv. (in wet places); *Athyrium Filix-foemina*, Roth; *Lastrea Filix-mas*, Presl; *Lastrea dilatata*, Presl.

The effect of shade—which is determined generally by the age of the trees and their distance apart—may be shown from another wood on the South Calder Water.

¹ Hirst—"a thick wood." Close at hand are two farms called "Blairmains" and "South Blair," respectively. Blair—"a part cleared of trees."

This wood is on rising ground. A few spruce and larch are mixed with the dominant Scots pine. On the outskirts of the wood are deciduous trees—beech, oak, birch, rowan, elm, and sycamore, seedlings of the rowan being common. Where the shade is dense and the covering of needles thick, plants are absent. In the opener spaces, however, most of the above are found along with *Oxalis Acetosella*, Linn.; *Lonicera Periclymenum*, Linn.; *Veronica Chamaedrys*, Linn.; and *Ranunculus repens*, Linn., towards the outside of the wood. In a wood farther to the west, where birch and rowan are numerous, the rasp (*Rubus idaeus*, Linn.) is abundant.

A study of the coniferous woods reveals the following characteristics of this formation and association:—

1. The dense shade affects both the trees and the undergrowth. The lower branches of the trees themselves decay, leaving bare stems with a dense crown. The undergrowth is either absent or very sparse, the plants present being mainly the two Xerophytes, *Deschampsia flexuosa*, Trin.; and *Vaccinium Myrtillus*, Linn.

2. The covering of decayed and decaying needles also prevents the development of undergrowth.

3. *Calluna*, when present, is found only in the opener and drier parts of the woods.

4. *Deschampsia caespitosa*, Beauv., *Cnicus pulustris*, Willd., and *Juncus*, spp., are characteristic of the wetter parts.

5. *Athyrium* and *Lastrea* form patches, occasionally of some extent, in the less dense parts of the woods.

6. Seedlings of birch, rowan, and willow frequently occur.

7. Many of the plants are invaders from the surrounding heaths or pastures.

The parish is by no means rich in woodland flora; in fact there can hardly be said to be any true woodland plants as such, except perhaps in the woods on the banks of the streams. The following, in addition to those already mentioned, are found:—*Anemone nemorosa*, Linn.; *Viola Riviniana*, Reichb.; *Stellaria Holosteu*, Linn.; *Hypericum pulchrum*, Linn.; *Vicia sepium*, Linn.; *V. sylvatica*, Linn. (recorded by Dr. Grossart for Fairybank district); *Spiraea*

Ulmaria, Linn.; *Rubus fruticosus*, Linn. (very poorly represented in the parish); *Geum urbanum*, Linn.; *G. rivale*, Linn.; *Fragaria vesca*, Linn.; *Rosa*, spp.; *Chrysosplenium oppositifolium*, Linn.; *Epilobium montanum*, Linn.; *Hedera Helix*, Linn.; *Cnicus heterophyllus*, Willd. (recorded by Dr. Grossart for Fortisset district; also found in the east of parish); *Primula vulgaris*, Huds.; *Stachys sylvatica*, Linn.; *Mercurialis perennis*, Linn. (forming communities in woods on South Calder Water); *Urtica dioica*, Linn.; *Listera ovata*, Br. (recorded by Dr. Grossart for Murdostoun woods); *Epipactis latifolia*, Sw. (recorded by Dr. Grossart for Murdostoun woods; also found in wood just outside eastern boundary).

Grassland.

This may be divided into three sections, all of which are represented in the parish:—

1. *Natural Pasture*.—Grasses are dominant, the soil is well drained, and there is an absence of peat. Under this heading is included the vegetation of the dolerite sills.

2. *Artificial Pasture and Meadowland*.—The soil has undergone tillage and is rich in plant food.

3. *Grass Heaths*.—Grasses are dominant but the flora is that of the moorland.

1. **NATURAL PASTURE**.—There are fair stretches of this vegetation, but it often passes into grass heath, and peat bog. It is, however, easily distinguished from these at a distance by its greener covering and compact turf. There is much difference in the grasses composing the various associations, the chief, however, are: *Festuca ovina*, Linn.; *Anthoxanthum odoratum*, Linn.; *Agrostis vulgaris*, With.; *Poa pratensis*, Linn.

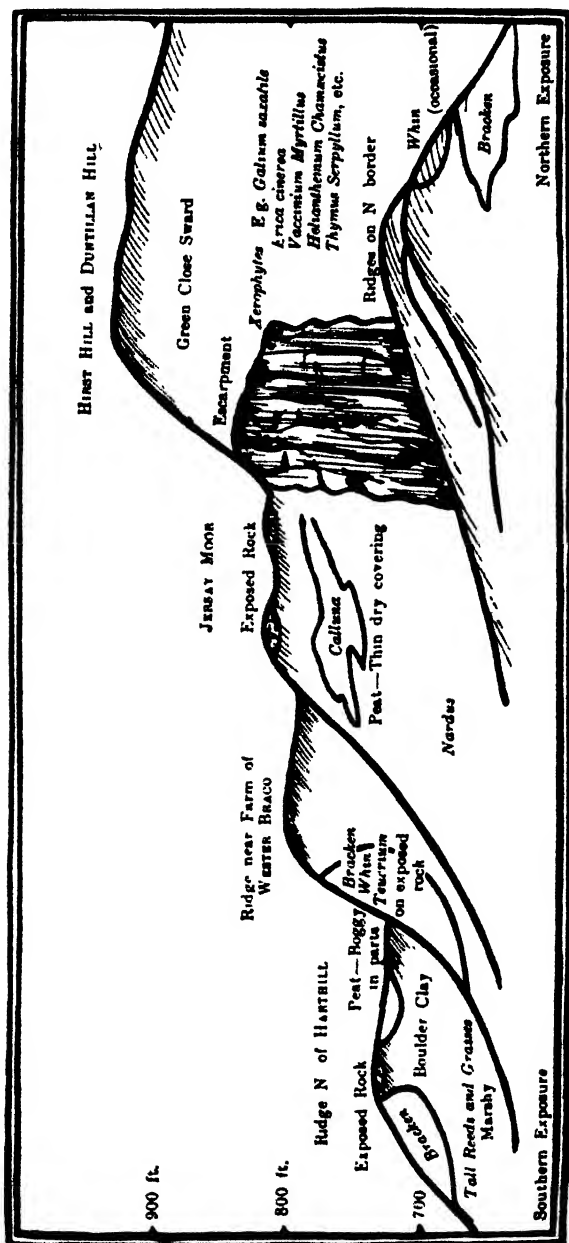
The flora is varied, the following plants occurring:—*Ranunculus acris*, Linn.; *R. repens*, Linn.; *Viola sylvatica*, Fries; *V. tricolor*, Linn.; *Polygala vulgaris*, Linn.; *Linum catharticum*, Linn.; *Trifolium pratense*, Linn.; *T. repens*, Linn.; *Lotus corniculatus*, Linn.; *Potentilla Tormentilla*, Scop.; *Alchemilla vulgaris*, Linn.; *Galium saxatile*, Linn.; *G. verum*, Linn.; *Scabiosa Succisa*, Linn.; *Gnaphalium sylvaticum*, Linn.; *Curlyna vulgaris*, Linn.; *Centaurea nigra*, Linn.; *Achillea Millefolium*, Linn.;

A. Ptarmica, Linn.; *Hieracium Pilosella*, Linn.; *Campanula rotundifolia*, Linn.; *Veronica officinalis*, Linn.; *Euphrasia officinalis*, Linn.; *Thymus Serpyllum*, Linn.; *Plantago lanceolata*, Linn.; *Rumex Acetosa*, Linn.; *R. Acetosella*, Linn.; *Urtica dioica*, Linn.; *Orchis maculata*, Linn.; *Habenaria viridis*, Br.; *H. bifolia*, Br.; *Briza media*, Linn.; *Pteris aquilina*, Linn.; *Ophioglossum vulgatum*, Linn.; *Botrychium Lunaria*, Sw.

VEGETATION OF DOLERITE SILLS.—As mentioned under Geology, a characteristic feature of the district is the number of transgressive sills of quartz-dolerite, the ridges ranging in height from 700 to over 900 feet. The rounded tops of these sills are clothed with grass which is usually shorter and greener than that of the adjoining region—for instance, in places, damp reedy grassland gives way to a dwarf grass covering with drier conditions, having the following plants—the list being made from one such case in the neighbourhood of Harthill:—*Potentilla Tormentilla*, Scop.; *Galium saxatile*, Linn.; *G. verum*, Linn.; *Scabiosa Succisa*, Linn.; *Campanula rotundifolia*, Linn.; *Thymus Serpyllum*, Linn.; with *Vaccinium Myrtillus*, Linn., and *Calluna vulgaris*, Hull, on dry mounds.

The following is a list from the dolerite knoll on the north side of the Lilly Loch. The plants are similar to those given for the basaltic hills of the Edinburgh district, and the hills of the Carboniferous area of Fife and Kinross:¹—*Trifolium repens*, Linn.; *T. pratense*, Linn.; *Lathyrus pratensis*, Linn.; *Potentilla Tormentilla*, Scop.; *Galium verum*, Linn.; *G. saxatile*, Linn.; *Scabiosa Succisa*, Linn.; *Achillea Millefolium*, Linn.; *A. Ptarmica*, Linn.; *Campanula rotundifolia*, Linn.; *Rumex Acetosa*, Linn.; *R. Acetosella*, Linn.; *Festuca ovina*, Linn.; *Agrostis*, spp.; *Poa pratensis*, Linn.; *Anthoxanthum odoratum*, Linn.; with *Ulex Europæus*, Linn., *Vaccinium Myrtillus*, Linn., *Calluna vulgaris*, Hull, and *Erica cinerea*, Linn., in occasional small patches; and *Polygala vulgaris*, Linn., *Oniscus lanceolatus*, Willd., *Centaurea nigra*, Linn., *Euphrasia officinalis*, Linn., *Plantago lanceolata*, Linn., and *Hieracium*, spp., at the foot of the escarpment.

¹ "Botanical Survey of Scotland—Edinburgh District"; "Botanical Survey of Scotland—Forfar and Fife."



Composite Sketch giving Typical Vegetation of Dolerite Sills.

Most of the above plants are also found on the steep southern escarpment of Hirst Hill, along with the following: —*Draba verna*, E. Meyer; *Helianthemum vulgare*, Gaertn.; *Geranium Robertianum*, Linn.; *Cytisus scoparius*, Link; *Prunus Padus*, Linn.; *P. spinosa*, Linn.; *Rosa canina*, Linn.; *Epilobium angustifolium*, Linn.; *Hedera Helix*, Linn.; *Lonicera Periclymenum*, Linn.; *Vaccinium Vitis-Idaea*, Linn.; *Teucrium Scorodonia*, Linn.; *Betula alba*, Linn.; *Corylus Avellana*, Linn.

Somewhat similar lists to those above were got from Duntillan Hill, and the high ridge near the farm of Wester Braco. On the dolerite of the latter (700 to 800 feet), with a south-western aspect, there is a conspicuous development of whin (*Ulex*) and bracken (*Pteris aquilina*, Linn.). Where the whin and bracken are in extensive patches there is an absence of other plants, but in the intervening spaces there is a covering of grass and other vegetation, the dominant plant being *Teucrium Scorodonia*, which clothes the rock in somewhat mat-like formations. The hawthorn (*Crataegus Oxyacantha*, Linn.) is present, scattered over the face of the rock.

Pteris aquilina, Linn., is found in some abundance on many of the southern slopes of these dolerite bosses. It is also present on some of the northern slopes—for example, on the ridges of the northern border of the parish to the west of Forrestfield.

2. ARTIFICIAL PASTURE AND MEADOWLAND. — This pasture is the grazing land for cattle in the cultivated areas. The grasses are of a more luxuriant growth, due to a greater richness of soil resulting from manuring, and there is greater variety:—*Anthoxanthum odoratum*, Linn.; *Phleum pratense*, Linn.; *Alopecurus pratensis*, Linn.; *Agrostis*, spp.; *Holcus lunatus*, Linn.; *Cynosurus cristatus*, Linn.; *Dactylis glomerata*, Linn.; *Festuca ovina*, Linn.; *F. pratensis*, Huds.; *Lolium perenne*, Linn.; *Poa pratensis*, Linn.; *P. trivialis*, Linn.

Many of the plants of the natural pasture are present along with the following: *Cerastium triviale*, Link; *C. glomeratum*, Thuill.; *Stellaria graminea*, Linn.; *S. media*, Vill.; *Vicia sepium*, Linn.; *V. Cracca*, Linn.; *Potentilla Anserina*, Linn.; *Spiraea Ulmaria*, Linn.; *Epilobium*

parviflorum, Schreb.; *Anthriscus sylvestris*, Hoffm.; *Galium Aparine*, Linn.; *G. cruciata*, Scop.; *Bellis perennis*, Linn.; *Chrysanthemum Leucanthemum*, Linn.; *Tussilago Farfara*, Linn.; *Senecio vulgaris*, Linn.; *S. Jacobaea*, Linn.; *Cnicus palustris*, Willd.; *C. arvensis*, Hoffm.; *C. lanceolatus*, Willd.; *Taraxacum officinale*, Weber; *Myosotis arvensis*, Hill; *Veronica Chamaedrys*, Linn.; *Rhinanthus Crista-galli*, Linn.; *Prunella vulgaris*, Linn.; *Ajuga reptans*, Linn.; *Plantago major*, Linn.; *Rumex crispus*, Linn.; *Polygonum aviculare*, Linn.; *P. Persicaria*, Linn.; *Equisetum arvense*, Linn.

3. GRASS HEATHS.—There is always present a certain amount of peat, and according to the amount of peat and water there is variation in the heath. In his survey of the vegetation of the Rivers Eden, Tees, Wear, and Tyne, F. J. Lewis distinguishes between two well-marked types of heath—

(1) *Molinia* Heath—having wet conditions of soil with peat and water in abundance, the plants being mainly sedges, grasses, and a few heather plants.

(2) *Nardus stricta* Heath—where the soil is dried and better drained, with peat less abundant, the covering being often very thin.

Both of these types may be distinguished in the parish. *Nardus stricta*, for example, occurs associated with *Calluna* on the sloping, dry ground of Jersay Moor, occurring in somewhat extensive patches. It is also found in many places of the moorlands associated with *Vaccinium Myrtillus*, but the grass usually associated with *Vaccinium* is the dry, wiry *Deschampsia flexuosa* which forms dense tussocks, and is dominant on most of the heaths of the parish. *Molinia varia* is characteristic of the low-lying, flat, and badly drained parts of the moors. The following are the chief plants found:—

Under dry conditions: *Nardus stricta*, Linn.; *Deschampsia flexuosa*, Trin.; *Agrostis vulgaris*, With.; *Potentilla Tormentilla*, Scop.; *Galium saxatile*, Linn.; *Vaccinium Myrtillus*, Linn.; *Calluna vulgaris*, Hull; *Erica Tetralix*, Linn.; *Luzula campestris*, DC.

Under wet conditions: *Molinia varia*, Schrank; *Deschampsia caespitosa*, Beauv.; *Lotus uliginosus*, Schkuhr;

Potentilla palustris, Scop.; *Calluna vulgaris*, Hull (on drier mounds); *Erica Tetralix*, Linn. (in small patches); *Narthecium ossifragum*, Huds.; *Juncus*, spp.; *Eriophorum vaginatum*, Linn.; *Carex*, spp.; *Sphagnum*, spp.

Moorland.

There are great stretches of moorland, imparting to it that bleakness which has become proverbial of the parish. Peat is developed more or less all over; from the district of Lilly Loch on the north-west—Lady Bell's Moss covering a large area—across to the south by Salsburgh to Jersay Moor and the region beyond; then to the east by Fortisset and Baton to the wide expanse of Benhar Moor which runs into Polkenmet and Fauldhouse Moors in Linlithgowshire; and on the north-east there is peat.

The grass heaths which should come under this heading also have already been dealt with.

Calluna is not found in very great abundance on the moors. It is occasionally found in somewhat extensive patches on the grass heaths, as on Jersay Moor. To the west of Hartwood there is some development of *Calluna*, but the ground has recently been planted with conifers and birches.

Sphagnum is found in the boggy parts, and associated with it are found the following plants:—*Drosera rotundifolia*, Linn.; *Vaccinium Oxyccus*, Linn.; *Erica Tetralix*, Linn.; *Pinguicula vulgaris*, Linn.; *Narthecium ossifragum*, Huds.; *Eriophorum vaginatum*, Linn.; *Juncus*, spp.; *Carex*, spp.

There are stretches of *Eriophorum* in places, e.g. in the north-east and south-east. The peat here is very thick and much water is present. *Eriophorum vaginatum*, Linn., and *E. angustifolium*, Roth, are both found—the waving of their silky heads doing much to relieve the monotony of the bleak, brown moorland. The extent of *Eriophorum* to the south-east—on Benhar Moor—may be of late development. Inquiries have elicited the fact that, previous to the opening up of the mineral resources of this district, about forty years ago, there was a great development of ling (*Calluna*) which, however, was killed off by the smoke and fumes from iron-stone burning.

It is interesting to notice how the various moorland associations merge into one another according as the environment changes, either as regards variation in the amount of moisture present or in the thickness of the peat.

The Flora of the Streams and Marshes.

Marshes and bogs occupy parts of the low-lying land, which is subjected to lengthened periods of submergence under water and to shorter periods of dry or less wet conditions. The roots, rhizomes, and, in many cases, the lower parts of the stems are under water, while the assimilating parts are aerial. Many of the plants are such as can adapt themselves to the varying conditions, partaking of such characteristics as the prevailing state of the soil requires. Reed swamps characterise such features as the reservoirs—one example being found at the western end of Forrestburn Reservoir. To the north-west of Lochill Farm, near Lady Bell's Moss, there is a somewhat extensive marsh where the vegetation appears to be zonally arranged. When this was visited, the ground around was so sodden, owing to heavy rains, that the marsh could not be thoroughly investigated, but closer study will yet be made. The various streams have many of the characteristic water plants.

The following are among the plants found in the streams and marshes:—

Ranunculus Flammula, Linn.; *R. hederaceus*, Linn.; *Caltha palustris*, Linn.; *Nuphar luteum*, Sibth. et Sm.; *Cardamine pratensis*, Linn.; *Lychnis Flos-cuculi*, Linn.; *Stellaria uliginosa*, Murr.; *Montia fontana*, Linn.; *Potentilla palustris*, Scop.; *Parnassia palustris*, Linn.; *Callitriche verna*, Linn.; *C. autumnalis*, Linn.; *Epilobium palustre*, Linn.; *Galium uliginosum*, Linn.; *Valeriana officinalis*, Linn.; *Senecio aquaticus*, Hill; *Lysimachia thyrsiflora*, Linn.; *Menyanthes trifoliata*, Linn.; *Myosotis palustris*, Hill; *Veronica scutellata*, Linn.; *V. Anagallis*, Linn.; *V. Beccabunga*, Linn.; *Pedicularis sylvatica*, Linn.; *P. palustris*, Linn.; *Pinguicula vulgaris*, Linn.; *Mentha aquatica*, Linn.; *Orchis maculata*, Linn.; *O. latifolia*, Linn.; *Iris Pseudacorus*, Linn.; *Juncus*, spp.; *Sparganium ramosum*, Curt.; *S. simplex*, Huds.; *Lemna*

minor, Linn.; *Potamogeton natans*, Linn.; *Carex*, spp.; *Equisetum palustre*, Linn.; *E. limosum*, Linn.

This survey of the vegetation of the parish is by no means exhaustive. Doubtless it is also imperfect and faulty owing to its being the work of one working alone. It is given as a first study of the vegetation on modern lines. Much remains to be accomplished in the study of distribution and the relationship existing between dominant, sub-dominant, and associated species.

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TWO NEW HIMALAYAN PRIMULAS FROM THE CHUMBI VALLEY. By W. W. SMITH, M.A.

Primula chumbiensis, W. W. Sm. Sp. nov.

Species valde affinis *Primulae reticulatae*, Wall.; forsan subspecies orta in valle tibetica Chumbi, multo minus humidiore quam provincia sikkinensis; interim pro specie propria melius habetur; foliis multo minoribus, coriaceis, bracteis subulatis, differt.

Planta 15–25 cm. alta, glabra, ut videtur lutaria, radicibus fibrosis crassis multis praedita. Folia petiolata; lamina 1–4 cm. longa (plerumque circ. 2.5 cm.), 1–2 cm. lata, ovato-

oblonga vel oblonga, basi rotundata vel cuneata vel cordatula, apice rotundata vel obtusissima, coriacea, serratula, margine paulo revoluta, rugosa, glabra, efarinosa, nervis reticulatis supra subobscuris; petiolus 2-4 cm. longus, laminam superans, membranaceo-alatus. Scapus elongatus, folia multo superans, 15-25 cm. longus, umbellam paucifloram (plerumque 3-4-floram) gerens; bracteae \pm 1 cm. longae, lineari-subulatae, parce farinosae; pedicelli 1-3 cm. longi, in fructu ad 8 cm. elongati; flores \pm nutantes. Calyx 7-8 mm. longus, tubulosus 5-costatus, vix ad medium fissus, farinosus; lobi anguste triangulari-lanceolati, acuminati, plerumque erecti. Corolla lutea; tubus 1.5-1.8 cm. longus, calycem longe superans, superne ampliatus, exannulatus; lobi suberecti ovati vix emarginati. Capsula cylindrica, calycem aequans vel paulo brevior.

Eastern Himalaya.—At Chumegati, in the Chumbi Valley, at an elevation of 15,000 feet, No. 317 Rohmoo in Herb. Edin; at Kalaeree in the Chumbi Valley at an elevation of 16,000 feet, No. 407 Rohmoo in Herb. Edin.

This species is undoubtedly closely allied to *Primula reticulata*, Wall., but differs markedly in the leaves. These are small and coriaceous. The plant grows probably in muddy places and is exposed to less continuously wet conditions during the flowering season than its ally in Sikkim; at times, no doubt, its habitat is almost dry.

Primula obliqua, W. W. Sm. Sp. nov.

Species *Primulae Stuartii*, Wall., valde affinis; umbellâ pauciflorâ, calycis lobis obtusis, corollâ obliqua fere albâ, petalis emarginatis, distinguitur; a *P. sikkimensi*, Hook. f., habitu et corollæ formâ facile separatur. Hæc species sikkimensis cum *P. Stuartii* ex Himalaya occidentali et centrali diu confusa est.

Planta robusta glabra 30-45 cm. alta, habitu *Primulae Stuartii*, basi squamis subfoliaceis membranaceis, in vivo carnosulis, 2-6 cm. longis, arcte obtecta. Folia petiolata; lamina 10-12 cm. longa, 2-3 cm. lata, anguste lanceolata, obtusa vel subacuta, subcoriacea, argute serrata vel serrato-crenulata, subtus pallido-farinosa, in petiolum laminam aequantem vel minorem, alatum, basi membranaceo-vaginantem, attenuata. Scapus elongatus, ad 45 cm. longus,

umbellam paucifloram (saepius 4-5-) gerens, \pm farinosus; bracteae \pm 6, circ. 1 cm. longae, subulatae, \pm farinosae; pedicelli 1-2 cm. longi; flores subcernui. Calyx farinosus 5-costatus, \pm 1 cm. longus, tubuloso-campanulatus, ad medium vel ultra fissus; lobi oblongi, apice obtusi vel rotundati, erecti. Corolla pallido-flava, fere alba, saepe obliqua et paululo irregularis; tubus fere 2 cm. longus, abrupte ampliatus; limbus circ. 2.5 cm. diametro; lobi rotundati emarginati. Capsula calycem superans cylindrica.

Eastern Himalaya.—In the neighbourhood of Changu, elevation 12,000 feet, Nos. 3269, 3580, 4546, *Smith* in Herb. Calc. et Herb. Edin.; at Gnatong, No. 4364, *King's Coll.*; Singalela Range, 12,300 feet, No. 5243, *Watt*; at Mon Lepcha, Jongri, 14,000 feet, No. 5604, *Watt*; also at Megu, Tari, and other Sikkim localities at an elevation 12,000-13,000 feet, without definite number, *native collectors*

This species is, no doubt, the East Himalayan representative of *Primula Stuartii*, but the points of difference are too many to allow of its being considered conspecific. The flowers are usually few in number, of a very pale yellow, almost white, and frequently with a somewhat zygomorphic corolla. Sir George Watt on sheet No. 5243 describes his flowers as "very large pale fleshy pink, very thick velvety in texture, and very delicately perfumed." It is evidently not the sulphur-yellow *P. Stuartii*. In the Chola Range in 1910 I found it closely associated with and growing freely among the *Rhododendrons* at 12,000 feet. It ranges above *P. sikkimensis*, Hook. f., and *P. reticulata*, Wall., but below *P. obtusifolia*, Royle, in that area.

A CONTRIBUTION TO THE FLORA OF ARRAN.

By WILLIAM G. TRAVIS.

This paper is the outcome of short holiday visits to the Isle of Arran, in August 1904 and July 1910. On the occasion of my second visit, my attention was largely devoted to the cryptogams, and the mosses and hepatics of my collecting enumerated hereinafter were then gathered.

In addition to the results of my own field-work, I have had the opportunity of examining some rich gatherings of cryptogamic plants made by Mr. Wm. West, F.L.S., in Arran, in August 1910. This material, on examination, has yielded a considerable number of interesting species additional to those noted by me; and Mr. West has kindly permitted me to include particulars of them in this paper.

The phaenogamous plants of the island are tolerably well known, and, accordingly, I propose to limit my notes principally to the more critical species of flowering-plants observed, but shall also mention a few plants which seem to be of local occurrence in the island.

As the Hepaticae have been listed by Mr. Symers M. Macvicar,¹ I need only mention some of the less common species observed, and a few which appear to be hitherto unrecorded for the island. So far as the mosses are concerned, I do not propose to mention all the species observed, but shall confine my list mainly to such species as are not given for v.c. 100 (Clyde Isles) in the "Census Catalogue" of the Moss Exchange Club. An asterisk denotes species or varieties not given for v.c. 100 in the "Census Catalogue," or in Mr. Macvicar's "List."

My sincere thanks are tendered to the following botanists, namely Charles Bailey, M.Sc., F.L.S.; Arthur Bennett, A.L.S.; E. Drabble, D.Sc.; G. C. Druce, M.A., F.L.S.; Rev. E. S. Marshall, F.L.S.; and Rev. W. Moyle Rogers, F.L.S., for help with the flowering plants; and in connection with the bryophyta, I am much indebted to Mr. Wm. West, F.L.S., for placing his gatherings at my disposal, and to Mr. J. A. Wheldon, F.L.S., for his aid in determining the *Sphagnum*, and checking my identifications in some doubtful cases.

Ranunculus acris, Linn., var. *Nathorstii* (Berl.). What is probably this plant occurs at the top of a steep gully, immediately below Cir Vhor, on the saddle between Glen Rosa and Glen Sannox. The plants I gathered were 6 to 7 inches high, with conspicuously large flowers. The fruit in my specimens is rather immature, but even in that state the carpels have a strongly hooked beak. Mr. Druce thinks the determination is probably correct. My specimens agree

¹ "List of Arran Hepaticae," Glasgow Naturalist, vol. ii., Feb. 1910.

very well with plants gathered by Messrs. Wheldon and Wilson at the head of Glen Eunach, E. Inverness, v.c. 96, altitude 2600 ft., July 1909 (see "Rept. Bot. Ex. Club" 1909, p. 435).

Viola obtusifolia, Jord. A garden weed at Brodick.

Viola Curtisii, Forst., var. *Pesneaui* (Lloyd). On the sand-dunes at Blackwater Foot. Specimens named by Dr. Drabble.

Cerastium tetrandrum, Curt. Sand-dunes, Blackwater Foot.

Sagina subulata, Presl. By the roadside, above Brown Head.

Spergula sativa, Boenn. On a bank by the roadside, above Brodick, on the way to Birks Glen.

Montia lumprospersma, Cham. Corrygills shore and other places.

Mulva moschata, Linn. On the sandy shore, near the hotel at Kildonan, 1904; not seen in 1910.

Mulva sylvestris, Linn. On the shore at Kildonan.

Rubus Sprengelii, Weihe. By the shore, at the mouth of the Glen Rosa burn.

Conium maculatum, Linn. About the ruins of Kildonan Castle.

Smyrniium Olusatrum, Linn. Occurs with *Conium maculatum* at Kildonan.

Achillea Millefolium, Linn., var. *villosa*, Hartm. Dunes at Blackwater Foot.

Lycopsis arvensis, Linn. Sandy fields near the shore, Blackwater Foot.

Lithospermum arvense, Linn. On the shore at Kildonan, August 1904.

Euphrasia borealis, Wetts. Corrygills. *E. curta*, Wetts. A small form of the type occurs in shallow hollows on sandstone rocks on the shore at Tormore. In the same habitat occurs a plant which Rev. E. S. Marshall refers to *E. brevipila* × *curta*. *Euphrasia gracilis*, Fr. Glen Rosa; and also in heathy ground by the roadside between Brodick and Lamblash, near the former place. *Euphrasia brevipila*, Burnat et Gremli. Marshy shore, Corrygills. "I have seen it in plenty near Loch Ranza," Rev. E. S. Marshall, "Rept. Bot. Ex. Club" 1910, p. 581. A small, very

glandular state occurs on the sandhills at Blackwater Foot.

Rhinanthus stenophyllus, Schur. Corrygills, teste G. C. Druce and Rev. E. S. Marshall, see "Rept. Bot. Ex. Club" 1910, p. 581.

Mentha alopecuroides, Hull. A few plants near the hotel at Kildonan.

Polygonum aviculare, Linn., var. *vulgatum*, Syme. A weed in garden ground at Brodick.

Carex distans, Linn. Corrygills shore. *Carex helodes*, Link (*C. luevigata*, Sm.). Marshy ground, Corrygills. *Carex Oederi*, Retz., var. *oedocarpa*, Anderss. Corrygills shore.

Agrostis alba, Linn. Specimens from the sandy shore at Kildonan were referred by Dr. E. Hackel to *A. alba*, var. *condensata*, Hackel, med. var. *couretata*, auct. plur. (see "Rept Bot. Ex. Club" 1910, p. 604).

Koeleria gracilis, Pers., var. *britannica*, Domin. Drumadon Point, teste Rev. E. S. Marshall. Associated with this was a small form of *Dactylis glomerata*, Linn., which was said by Dr. Hackel to be only a starved state (f. *macra*).

Musci.

Sphagnum papillosum, Lindb., var. *normale*, W. Corrygills: Birks Glen. * *S. teres*, Angstr., var. *imbricatum*, W. Corrygills. * *S. subnitens*, R. et W., and * *S. parvifolium*, W. Corrygills. *S. recurvum* (P. B.), var. *mucronatum*, W. Birks Glen. * *S. fimbriatum*, Wils. Birks Glen.

* *Tetraphis pellucida*, Hedw. Very common.

* *Swartzia montana*, Lindb., c. frt. Near Corrie.

* *Dicranella heteromalla*, Schp., c. frt. Near Corrie, West.

Blindia acuta, B. et S., var. * *trichodes*, Braithw., c. frt. Sandstone rocks on the shore at Corrygills.

* *Dicranoweisia cirrata*, Lindb., c. frt. Corrie, West.

Campylopus fragilis, B. et S. Corrie, West. *C. atrovirens*, De Not. Sannox and Goat Fell, West; marshy shore, Corrygills.

* *Dicranum Bonjeani*, De Not. Corrygills. *D. scoparium*, Hedw., var. * *orthophyllum*, Brid. Sandhills, Blackwater Foot; sandy shore, Brodick.

* *Fissidens viridulus*, Wahl. On clayey earth among shady rocks in a limestone quarry, Corrie.

Grimmia apocarpa, Hedw., c. frt. *G. maritima*, Turn. Sandstone rocks, Corrygills; on a stone on the sandhills, Blackwater Foot. *G. pulvinata*, Sm., c. frt. Common on the shore rocks. * *G. Hartmuni*, Schp. On rocks in Glen Monamore, West. It was associated with *Heterocladium heteropterum*, *Scapania nemorosa*, and *Fissidens adiantoides*. * *G. trichophylla*, Grev. On boulders, Dippen.

Rhacomitrium heterostichum, Brid., var. * *gracilescens*, B. et S. Granite boulders, Glen Rosa; near Brodick, West.

Tortula muralis, Hedw., var. * *rupestris*, Schultz, c. frt. On limestone rocks in a quarry at Corrie. * *T. intermedia*, Berk. On boulders, Bennan Head.

* *Barbula rigidula*, Mitt., c. frt. Corrie

* *Weisia viridula*, Hedw., c. frt. On clayey earth in a limestone quarry at Corrie; associated with *Fissidens taxifolius* and *F. viridulus*. *W. curvirostris*, C. M., var. * *commutata*, Dixon. Vertical shady rocks, Corrie, West. * *W. verticillata*, Brid. Near Brodick and Corrie, West; shady sandstone rocks, King's Caves; limestone quarry, Corrie.

Trichostomum crispulum, Bruch., var. * *elatum*, Schp. Corrie, West; sandstone rocks, Corrygills shore.

* *Trichostomum mutabile*, Bruch., var. *littorale*, Dixon. Glen Shirag; sandstone rocks, Tormore.

Zygodon viridissimus, R. Brown. On sycamores, Lam-lash, West. * *Z. conoideus*, Hook. et Tayl. On alders, Lam-lash, West. It was associated with *Hypnum resupinatum*, *Metzgeria furcata*, etc.

Orthotrichum rupestre, Schleich., c. frt. Rocks at Bennan Head. *O. anomalum*, Hedw., var. * *saratile*, Milde, c. frt. On limestone rocks in a quarry at Corrie. * *O. Lyellii*, Hook. et Tayl. On the bark of trees, near Lam-lash, West. * *O. stramineum*, Hornsch., c. frt. On the bark of trees, Brodick.

* *Funaria ericetorum*, Dixon, c. frt. Corrygills shore.

* *Bartramia ithyphylla*, Brid., c. frt. Corrie, West.

* *Neckera complanata*, Hüb. Corrie, West.

Pterogonium gracile, Swartz. On rocks and boulders, Bennan Head.

Brachythecium albicans, B. et S. Sandy shore, Brodick ; sandhills, Blackwater Foot. * *B. salebrosum*, B. et S., c. frt. Shady rocks, Corrie, West. * *B. plumosum*, B. et S., c. frt. On stones in stream, Birks Glen.

Eurhynchium Teesdalei, Schp. Shady rocks, King's Caves.

Hypnum stellatum, Schreb., c. frt. Marshy ground, Corrygills shore. It occurred along with *H. polygamum* and *H. revolvens*. *H. cupressiforme*, Linn., var. *resupinatum*, Schp. Very common on the bark of trees.—var. * *filiforme*, Brid. On bark, Corrie, West.—var. * *ericetorum*, B. et S. Glen Rosa and at Blackwater Foot ; doubtless common all over the island.—var. * *tectorum*, Brid. Sandhills, Blackwater Foot ; sandy shore, Invercloy. *H. scorpioides*, Linn. Marshy ground on the shore between King's Caves and Tormore. *H. sarmentosum*, Wahl. Marshy ground, Corrygills shore.

* *Hylocomium brevirostre*, B. et S. On tree trunks, Brodick ; Corrie, West

Hepaticae

* *Aneura major* (Lindb.), K. Muller. Near Brodick, West ; marshy ground, Corrygills shore.

* *Fossombroniat*, sp. A *Fossombroniat* occurred, along with *Scapania irrigua*, on wet soil on the shore, a few hundred yards east of Brodick Pier, but unfortunately it was not in satisfactory fruiting condition to enable it to be positively named. No *Fossombronias* are recorded for Arran in Macvicar's list.

Gymnomitrium concinnatum (Lightf.), Corda. On rocks in the saddle between Glen Rosa and Glen Sannox. *G. crenulatum*, Gottsche. On granite boulders, Glen Rosa.

Aplozia crenulata (Sm.), Dum. In several places near Corrie, West.

* *Lophozia excisa* (Dicks.), Dum. Under herbage on the shady side of sand-dunes, Blackwater Foot.

Plagiochila punctata, Tayl. Corrie, West.

Cephalozia Francisci (Hook.), Dum. Banks of the Glen Shirag burn, near the bridge on the way to Glen Rosa.

* *Cephaloziella bifida*, Schffn., c. frt. Sand-dunes, Blackwater Foot. Associated with *Lophozia excisa*.

Adelanthus decipiens (Hook.), Mitt. Corrygills.

Scapania irrigua (Nees), Dum. Marshy ground. Corrygills shore.

Madotheca laevigata (Schröd.), Dum. Corrie, West.

Microlejeunea ulicina (Tayl.), Evans. On the bark of birch trees, Sannox; also Birks Glen.

Marchesinia Mackaii (Hook.), Gray. Corrie, West.

Frullania fragilifolia, Tayl. On pitchstone rocks, on the shore at Tormore.

It will supplement in some respects the foregoing list if I conclude my paper with some notes briefly describing the phytogeography of the Corrygills shore and the sandhills at Blackwater Foot, places to which particular attention was devoted, and which consequently figure prominently in the foregoing list.

I may add that my attention has been mainly directed to the littoral flora, which, in fact, offers more of interest to the botanist than that of the mountains, for the lofty granite massif in the north of the island, though attaining an elevation of 2866 ft. in Goat Fell, has, as is generally well known, a montane flora which is poor compared with that of most Scotch mountains.

The Corrygills shore forms part of what is known geologically as the 25-ft. raised beach. This raised beach can be traced at various points on the coast of Arran, and can be well seen between Brodick and Corrygills Point. The raised beach here forms a narrow shelf or platform, often not more than 100 to 200 yards wide, the result of the marine erosion of sandstones and conglomerates of Triassic age. These sedimentary rocks are frequently traversed by dykes of igneous rocks, such as basalt, dolerite, pitchstone, etc. In a paper of this character justice cannot be done to the botanical interest of this ground; but the varied nature of the plant associations, and the occurrence in close association of plants of very diverse types of distribution, may be best illustrated by giving the following selection from a list of plants noted by me in a short walk along the Corrygills shore: — *Cochlearia officinalis*, Linn.; *Sagina nodosa*, Fenzl; *Spiraea Ulmaria*, Linn.; *Geum rivale*, Linn.; *Comarum palustre*, Linn.; *Parnassia palustris*, Linn.;

Sedum anglicum, Huds.; *Drosera rotundifolia*, Linn.; *Lythrum Salicaria*, Linn.; *Apium graveolens*, Linn.; *Oenanthe crocata*, Linn.; *Eupatorium cannabinum*, Linn.; *Aster Tripolium*, Linn.; *Crepis paludosa*, Moench; *Armeria maritima*, Willd.; *Anagallis tenella*, Murr.; *Erythraea littoralis*, Fries; *Menyanthes trifoliata*, Linn.; *Pedicularis palustris*, Linn.; *Pinguicula vulgaris*, Linn.; *P. lusitanica*, Linn.; *Myrica Gale*, Linn.; *Orchis maculata*, Linn.; *Hubenaria virescens*, Druce; *Iris Pseudacorus*, Linn.; *Narthecium ossifragum*, Huds.; *Scirpus pauciflorus*, Lightf.; *S. caespitosus*, Linn.; *Schoenus nigricans*, Linn.; *Carex helodes*, Link; *C. Oederi*, Retz.; *Selaginella selaginoides*, Link; *Blindia acuta*, B. et S.; *Campylopus atrovirens*, De Not.; *Dicranum Bonjeani*, De Not.; *Grimmia maritima*, Turn.; *G. pulvinata*, Smith; *Trichostomum crispulum*, Bruch; *Ulota phyllantha*, Brid.; *Funaria ericetorum*, Dixon; *Bryum atropurpureum*, Web. et Mohr; *Hypnum sarmentosum*, Wahl.; *Adelanthus decipiens* (Hook.), Mitt.; *Scapania irrigua* (Nees), Dum.

Some light will be thrown on the florula of this shore by a brief sketch of the principal types of plant habitat, and corresponding plant-associations, which may be met with in many places by crossing the raised-beach platform from the tidal rocks at its seaward edge to the old sea-cliffs at its inner margin. Immediately above the tidal zone are outcropping rocks which support only a scanty vegetation (mainly cryptogams), but one which is of considerable interest ecologically.¹

These rocks and the sandy or muddy ground about them constitute a narrow belt to which the maritime species are largely restricted. Where the ground is muddy and subject to tidal influence, it approximates closely to salt-marsh, and yields the halophytes and other maritime species mentioned. At other points, the soil is a wet, muddy

¹ The vegetation of the barer rocks is practically restricted to lichens, prominent among which are the following species:—*Physcia aquila*, Nyl.; *P. parietina*, De Not.; *Lecanora parella*, Ach.; *L. atra*, Ach.; *Ferrucaria maura*, Whilb.; *Lichina confinis*, Ag.; etc. In the colonisation of these maritime rocks, the lichens are closely followed by several bryophytes, e.g., the mosses, *Grimmia pulvinata*, Sm.; *G. apocarpa*, Hedw.; *G. maritima*, Turn.; *Ulota phyllantha*, Brid.; and the hepatics, *Metzgeria furcata* (Linn.), Dum., and *Frullania Tamarisci* (Linn.), Dum.

sand, and among the plants here to be met with are:—*Sagina maritima*, Don; *S. nodosa*, Fenzl; *Samolus Valerandi*, Linn.; *Erythraea littoralis*, Fries; *Scirpus pauciflorus*, Lightf.; *Blysmus rufus*, Link; *Carex glauca*, Scop.; *C. extensa*, Good.; *C. Oederi*, Retz.; *Funaria ericetorum*, Dixon; *Bryum atropurpureum*, Web. et Mohr, etc. This zone merges into a marshy tract formed by copious drainage from the higher ground; and here all maritime influence seems to be neutralised. The plant-associations of this boggy ground are very variable in character within areas of quite limited size. They comprise in the main fresh-water marsh and *Sphagnum* bog, with, in places, a development of *Scirpus-Eriophorum* bog, with *Potentilla Tormentilla*, Scop.; *Drosera rotundifolia*, Linn., *Calluna vulgaris*, Hull (sparingly); *Erica Tetralix*, Linn.; *Myrica Gale*, Linn.; *Narthecium ossifragum*, Huds.; *Scirpus caespitosus*, Linn.; *Eriophorum vaginatum*, Linn.; etc. Finally, at the inner margin of the raised beach we reach old sea-cliffs, with shaded, dripping rocks, rich in ferns and mosses, and sometimes thinly clothed with trees, principally birch, mountain ash, and oak.

On the western side of the island, at Blackwater Foot, there is a small tract of blown-sand. The following is a list of the characteristic and more interesting plants of the dunes:—*Brassica monensis*, Huds.; *Viola Curtisii*, Forster; *Cerastium tetrandrum*, Curt.; *Arenaria peploides*, Linn.; *Erodium cicutarium*, L'Hérit.; *Lotus corniculatus*, var. *crassifolius*, Pers.; *Prunus spinosa*, Linn.; *Rubus caesius*, Linn.; *Potentilla Anserina*, Linn.; *Rosa spinosissima*, Linn.; *Sedum anglicum*, Huds.; *S. arre*, Linn.; *Eryngium maritimum*, Linn.; *Daucus Carota*, Linn.; *Galium verum*, Linn.; *Filago germanica*, Linn.; *F. minima*, Fr.; *Senecio sylvaticus*, Linn.; *Jasione montana*, Linn.; *Calluna vulgaris*, Hull; *Convolvulus Soldanella*, Linn.; *Euphrasia brevipila*, Burnat et Gremli; *Thymus Serpyllum*, Linn.; *Atriplex laciniata*, Linn.; *Polygonum Roberti*, Loisel.; *Rumex Acetosella*, Linn.; *Carex arenaria*, Linn.; *Ammophila arenaria*, Link; *Airu praecox*, Linn.; *Agropyron junceum*, Beauv.; *Pteris aquilina*, Linn.; *Catharinea undulata*, Web. et Mohr; *Polytrichum juniperinum*, Willd.; *Ceratodon purpureus*, Brid.; *Dicranum*

scoparium, var. *orthophyllum*, Brid.; *Racomitrium heterostichum*, Brid.; *Brachythecium albicans*, B. et S.; *B. purum*, Dixon; *Hypnum cupressiforme*, var. *ericetorum*, B. et S.; and var. *tectorum*, Brid.; *Hylocomium splendens*, B. et S.; *Lophozia excisa* (Dicks.), Dum.; and *L. ventricosa* (Dicks.), Dum.

The dunes are large and well developed, but are of the dry type, and there is little differentiation between the vegetation of the hollows and that of the hillocks. The sand evidently contains but little lime, judging by the presence in quantity of such plants as *Racomitrium heterostichum*, Brid.; *Pteris aquilina*, Linn.; *Senecio sylvaticus*, Linn.; and *Calluna*, which, in my experience, are rare on, or absent altogether from, sand-dunes where the sand has a small lime content due to the admixture with it of shell fragments. *Calluna* is developed principally towards the rear of the dune tract; bracken, however, is a conspicuous component of the vegetation in all parts, except on the bare outermost dunes.

THE INVASION OF VEGETATION INTO DISFORESTED LAND.

By N. MILLER JOHNSON, B.Sc., F.L.S.

Introduction.

During the summer of 1911 the writer's attention was drawn to the vegetation of a piece of land between Gallowtown and Thornton (Fife), evidently in a transition stage, and some investigation was accordingly made chiefly from the point of view of invasion. It appears on inquiry that up till two years previously the land had supported a fairly mature wood of Scots pine and spruce when, the trees being cut down, the ground was allowed to lie fallow. This land, lying adjacent to, and parallel with, the railway which runs almost due north and south between Dysart and Thornton, is, roughly speaking, about one mile in length and between 100 and 150 yards in breadth.

Rising slightly from the south end, the land is fairly

level for about one-third of the entire distance, and then slopes gently towards the north, culminating in a rather low-lying portion where water tends to accumulate. The higher parts are about 250 feet above sea-level.

Soil.

The soil of this part of Fife, resting on the coal measures, is a loam consisting of clay from the boulder clay and shale, and sand from the sandstone rocks, many boulders of which are to be found in the clay. This loam, however, is by no means uniform in its composition. In order to make comparisons between various parts of the habitat as regards moisture, a few samples of soil were obtained, and the water content and the water-holding capacity estimated, the percentages being calculated on the dry weight in each case.

The results may be tabulated as follows:—

Association from which Soil was Obtained.	Colour and Consistency before Drying.	Colour after Drying.	Water Content (percentage).	Water-holding Capacity.
Grass association (S. end)	A brown loam	Light yellow brown	24.6	50
<i>J. effusus</i> and young birch association (middle)	A brown loam	Light grey brown	19.5	18
<i>Juncetum communis</i> (N. end)	A dark brown clayey soil	Almost black (much humus)	80	75

Vegetation.

The vegetation of the land, which till recently was closely covered with trees, is open, this being the usual condition after tree-covering. Many bare patches of soil are present, which will gradually become covered as time goes on. The land is now under conditions favourable to becoming a closed vegetation, hence one expects to find evidences of the transition. It is very narrow, and this narrowness makes it liable to invasion. The present con-

dition may be briefly outlined as follows:—At the south end where the land comes in contact with meadow, certain grasses such as *Poa pratensis*, Linn., *Holcus lanatus*, Linn., *Agrostis alba*, Linn., and *Anthoxanthum odoratum*, Linn., predominate.

Further north the dominant social species in addition to grasses are *Rubus idaeus*, Linn., and *Pteris aquilina*, Linn.; subordinate associations being characterised by *Ranunculus repens*, Linn.; *Lychnis diurna*, Sibth.; *Oxalis Acetosella*, Linn.; *Trifolium repens*, Linn.; *Spiraea Ulmaria*, Linn.; *Sanicula europaea*, Linn.; and *Cnicus arvensis*, Hoffm.

This decidedly mixed vegetation gives way, nearer the middle, to a more consistent type. Here the dominant plants are rushes (*Juncus effusus*, Linn.) and seedling birches, the latter, owing to the proximity of an older natural self-sown birch wood on the other side of the railway line, being present in great abundance. Subordinate associations in this zone are *Epilobium angustifolium*, Linn.; *Senecio viscosus*, Linn.; *Cnicus palustris*, Willd.; *Prunella vulgaris*, Linn.; *Rumex Acetosa*, Linn.; and *R. Acetosella*, Linn.

Epilobium angustifolium is notable as a "clearing" plant especially on burnt patches. Indeed it is known as "Fireweed" in America.

This zone passes into a rather different one again, about eighty yards in length. Here *Juncus effusus*, Linn., and *Rubus idaeus*, Linn., are the dominant social species. In some places they are associated together, but in others the former is found with *Potentilla erecta*, Hampe, while with the latter are found small societies of *Veronica officinalis*, Linn. *Poa pratensis*, Linn., is here notable as a marginal plant, subordinate associations being *Rumex Acetosella*, with *Anthoxanthum odoratum*; while of the smaller societies *Carex distans*, *Luzula campestris*, *Galium saxatile*, and *Agrostis alba* may be mentioned. From this point onwards the land slopes gently until it becomes quite low lying, that is, tends to become a "flush" or bog. *Juncus effusus*, Linn., with *J. articulatus*, Linn., and *Deschampsia caespitosa*, Beauv., are the dominant plants; the rasp is locally abundant; while subordinate associations

are characterised by *Anthoxanthum odoratum*, Linn.; *Agrostis alba*, Linn.; and *Rumex Acetosella*, Linn. Other plants are noticeable here, viz. *Cardamine pratensis*, Linn.; *Viola Riviniana*, Reichb.; *Cerastium glomeratum*, Thuill.; and *Gnaphalium uliginosum*, Linn. Birch seedlings also occur.

Plant Associations.

The plant associations of this disforested land are (1) partly remnants of woodland, and (2) partly newer associations, the origin of which we propose to indicate.

1. REMNANTS OF WOODLAND. — *Viola Riviniana*, Reichb.; *Oxalis Acetosella*, Linn.; *Ulex europaeus*, Linn.; *Cytisus scoparius*, Link; *Rubus idaeus*, Linn.; *Potentilla erecta*, Hampe; *Galium saxatile*, Linn.; *Juncus effusus*, Linn.; *Anthoxanthum odoratum*, Linn.; *Agrostis alba*, Linn.; *Deschampsia caespitosa*, Beauv.; *Poa pratensis*, Linn.; *Pteris aquilina*, Linn.; *Aspidium Filix-mas*, Sw.; *A. spinulosum*, Sw.: with *Acer Pseudo-platanus*, Linn., *Rosa*, sp., *Crataegus monogyna*, Jacq., *Sambucus nigra*, Linn., *Betula tomentosa*, Reith et Abel, *Alnus glutinosa*, Gaertn., *Quercus Robur*, Linn., *Salix caprea*, Linn., marginal or at edges of drains.

Robert Smith (1) in discussing the vegetation of Belstane pine wood makes the following observations regarding some of the above species —

Deschampsia caespitosa, Beauv.—Edges of drains (flushes), competing in marshy places with rushes.

Poa, *Holcus*, and *Agrostis* carpet the well-drained parts where the soil is good.

Galium saxatile, Linn.—Associated with both heather and grasses.

Rushes occur on the wet clay soils.

In addition to these species *Anthoxanthum odoratum*, Linn., is frequent, carpeting the paths in pine woods generally.

Among the principal sub-associations of the ground vegetation in a pine wood on the Sidlaws, W. G. Smith (2) mentions the following:—

Cytisus scoparius, Link, and *Ulex europaeus*, Linn.—Occasional where shade slight.

Rubus idaeus, Linn.—Especially with birch and rowan.

Anthoxanthum odoratum, Linn.—Strongly social, large patches under trees.

Deschampsia caespitosa, Beauv., and *Juncus*, spp.—Flush plants, occupying wet parts.

Regarding the species classed as remnants of woodland, a great deal must perforce be speculative, as certain species of plants are known to occur in pine woods, and yet in other localities may be typical invaders. The following list by Robert Smith (1), known to consist of species "mostly of the invading class," will serve to illustrate this:—

**Ranunculus repens*, Linn.

**Spiraea Ulmaria*, Linn.

Juncus conglomeratus, Linn.

**Phalaris arundinacea*, Linn.

} Flush plants.

*†*Rubus idaeus*, Linn.; †*R. fruticosus*, Linn.; *Fragaria vesca*, Linn.; *Urtica dioica*, Linn.; *†*Anthoxanthum odoratum*, Linn.; †*Agrostis vulgaris*, With.; *†*Deschampsia caespitosa*, Beauv.; †*Holcus mollis*, Linn.; *†*H. lanatus*, Linn.; *†*Lastrea Filix-mas*, Presl; †*Polytrichum commune*, Linn.; *Pellia epiphylla*, Linn.

Those species known to occur both in pine woods and as invaders are marked †; those found in the present habitat *; while invaders absent from the vegetation under discussion are unmarked.

2. NEWER ASSOCIATIONS.—After the felling of the trees the present habitat would, except for the original undergrowth, be denuded, and one would therefore expect that the first phase of colonisation would be effected by those plants possessing exceptional modes of dissemination.

It will be seen from the following list of species actually found, that the majority possess in a high degree facilities for distribution by the wind:—

1. WIND DISTRIBUTED. (1) Winged, margined, or awned fruits and seeds.—*Acer Pseudo-platanus*, Linn.; *Rumex Acetosa*, Linn.; *Betula tomentosa*, Reith et Abel; *Alnus glutinosa*, Gaertn.; *Anthoxanthum odoratum*, Linn.; *Agrostis alba*, Linn.; *Holcus lanatus*, Linn., et *Mollis*, Linn.; *Poa pratensis*, Linn.

(2) Parachute fruits and seeds.—*Epilobium angustifolium*, Linn.; *Gnaphalium uliginosum*, Linn.; *Senecio*

viscosus, Linn.; *Cnicus palustris*, Willd.; *C. arvensis*, Hoffm.; *Salix caprea*, Linn.

(3) Species in which either whole fruit head or fruit is wind distributed.—*Cerastium glomeratum*, Thuill.; *Veronica officinalis*, Linn.; *V. Chamaedrys*, Linn. (seeds washed out by rain: Kerner); *Prunella vulgaris*, Linn.; *Juncus effusus*, Linn.; *J. articulatus*, Linn.; *Luzula campestris*, DC.; *Carex distans*, Linn.

(4) Seeds ejected by being shaken from capsule by wind.—*Lychnis diurna*, Sibth.; *L. Flos-cuculi*, Linn.

2. DISTRIBUTED by HOOKED FRUITS. — *Ranunculus repens*, Linn. (see also 3); *Circaea lutetiana*, Linn.; *Sanicula europaea*, Linn.

3. OFF-SHOOT DISTRIBUTED (wandering plants).—*Ranunculus repens*, Linn. (above-ground runner) (see 2); *Trifolium repens*, Linn.; *Spiraea Ulmaria*, Linn. (underground runner); *Curdamine pratensis*, Linn. (from roots and a bud on lowest leaves).

Agrostis alba, Linn., *Anthoxanthum odoratum*, Linn., and *Poa pratensis*, Linn., also possess runners.

It may prove interesting for the sake of comparison to mention briefly the flora of other pieces of disforested land:—

(1) A piece of land in the same area which some five or six years ago supported a pine wood. This land is surrounded on all sides by chiefly coniferous woodland.

Altitude, 200 feet. Soil, dark brown, peaty, with much humus. Water content, 200 per cent.

Vegetation open. *Juncus effusus* dominant.

Other plants.—*Cerastium glomeratum*, Thuill.; *Rubus idaeus*, Linn.; *Galium saxatile*, Linn.; *Senecio-Jacobaea*, Linn.; *Calluna vulgaris*, Hull; birch seedlings; *Polytrichum commune*, Linn.; *Ceratodon purpureus*, Brid.

(2) A piece of land north of Kennoway (Fife) which some six or seven years ago supported a pine and spruce wood. It is bounded on two sides by cultivated land, on the north by a coniferous wood, and on the west by a beech wood.

Altitude, 600 feet. Soil, a brown loam light. Water content, 34 per cent.

Vegetation closed. *Calluna vulgaris* dominant.

Other plants.—*Viola Riviniana*, Reichb.; *Potentilla*

erecta, Hampe; *Vaccinium Myrtillus*, Linn.; birch seedlings; *Polytrichum commune*, Linn.; and other mosses.

The plant associations of this disforested land evidently come within the scope of the migratory formations of Crampton (4), who mentions the "tendency on the part of the plants of the more stable formations to eventually obtain possession of areas formerly occupied by migratory formations on the one hand, and of certain plants of the migratory formations to invade disturbed areas of the stable formation on the other."

Tansley (5) points out that both in the plant formation of clays and loams and the plant formation of sandy soil, retrogressive associations are known — consequent upon the clearing of woodland, and represented by scrub and grassland.

Clements (3) regards invasion as including both migration and ecesis, *i.e.* the adjustment of a plant to its habitat, and defines the term as follows:—

"By invasion is understood the movements of plants from an area of a certain character into one of a different character, and their colonisation in the latter."

Warming (6) observes that when new soil arises anywhere it is soon invaded by plants, and points out that new soil may be produced by various agencies, man included. The early vegetation of new soil is open, and many species are found to belong to the local weed-flora.

Regarding the future of this land one can only speculate. It, however, appears probable that in the higher parts grasses will eventually predominate and that a rough meadow will result. On the other hand, the present numbers of *Rubus idaeus* may increase and tend to militate against this by forming scrub or thicket. The predominance of *Juncus effusus* and the abundance of *J. articulatus* and *Deschampsia caespitosa* would appear to indicate that the lower lying and damper portions of the present habitat are already being covered with a *Juncetum communis* (of "Types").

The higher association of *Juncus effusus* containing so many young birch trees, if left undisturbed, will undoubtedly pass into a natural birch wood, as has occurred on the other side of the railway line.

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A REVISION OF THE GENUS COCHLEARIA IN BRITAIN.
I. COCHLEARIA DANICA, LINN By M'TAGGART COWAN.

For a considerable time I have been engaged in the study of the genus *Cochlearia* in Britain, and in the cultivation under similar conditions of the numerous forms assumed by the very variable species of this genus. A large amount of both living and dried specimens have passed through my hands, and numerous notes have been made in the field. Field work is of especial importance in dealing with these very critical plants, as otherwise a very erroneous opinion of the value of the various forms is likely to be arrived at. Where possible, the plants in their native localities were visited at different periods of the year.

The cultivation tests also gave most valuable results, many of the most striking forms in the field reverting at once to type when under cultivation. This was particularly so in the *C. vulgaris* group. Others, on the other hand, were found to be remarkably constant.

The present paper is confined to the consideration of *C. danica*, Linn., as the other species still require further consideration, and it is intended to treat of these in a later paper.

My thanks are due to many botanists for their help in sending material for study, and to Professor Balfour for permitting the cultivation experiments to be carried on under suitable conditions in the Royal Botanic Garden; to Mr. W. W. Smith for much assistance in making out the

descriptions, and to Mr. Arthur Bennett, A.L.S., for many of the records.

The figure in "English Botany" is a very fair representation of the Linnean type, but the detailed examination of the species as occurring in Britain has shown that *C. danica* falls naturally into three well-marked sections, and after cultivation tests in which the distinguishing features have proved wonderfully constant, I have thought it well for a better understanding of the species that it be divided into three varieties, of which I herein give detailed descriptions.

Cochlearia danica, Linn.

(a) *Typica*, var. nov.—Planta robusta. Radix annua. Caules saepius multi e basi orientes procumbentes. Folia saepius angulata, nitenti-viridia, carnosa; superiora caulina breviter petiolata vel subsessilia, hederæformia, nervis supra impressis, infra eminentibus. Flores vix compacti.

Plant annual (probably usually a "winter annual"). Foliage deep glossy green, fleshy. Radical leaves cordate, or 3-5-lobed, or angled, sometimes entire, rather long petioled, more or less deeply veined. Lower cauline leaves stalked, not usually exceeding radical leaves, upper shortly stalked or subsessile, hederate, deeply-veined. Stem channelled procumbent, simple or branched, at first short but lengthening during flowering. Flowers pale pink or white. Petals short, ovate, limb rather abruptly narrowed into the claw. Sepals rather large, narrowly elliptical lanceolate, hooded, green, usually more or less tinged with reddish-brown, especially towards the apex. Pods ovate, slightly flattened at the ends, turgid, conspicuously veined when ripe, style distinct. Seeds small, tubercled, deep brown.

This variety is fairly common in England and Ireland, but less so in Scotland.

(b) *Suberecta*, var. nov.—Planta gracilis. Radix annua. Caulis saepius solitarius erectus, substrictus, flexibilis, in fructu subnutans. Folia minus nitentia, infra nonnunquam purpurascens, vix carnosula; radicalia numerosa, parva, ascendens, mox emarcescens; petiolus gracillimus; caulina omnia petiolata, hederæformia, nervis venulisque

gracillimis sed non obscuris, subremota. Silicula minor, minus turgida quam eae varietatum aliarum.

Plant annual. Radical leaves small, very numerous, ascending, cordate, entire or obscurely 3-5-lobed, dull green, not fleshy, petioles very slender, hair-like, soon dying down. Lower cauline leaves stalked, not usually exceeding radical leaves, upper all stalked, decreasing in length with distance from root, hederate, leaves and stem often tinged with purple brown. Stems frequently single, slender, erect, simple or branched, wiry, sometimes forming close tufts. Flowers opening rather widely. Fruiting racemes lengthening considerably and falling over. Pods small, scarcely flattened at the ends, less swollen than in (a) or (c), pedicels rather long, $1\frac{1}{2}$ -2 times length of pod. In its early stages this variety bears a strong resemblance to *Saxifraga tri-dactylites*, Linn.

Common on south English coast, and also recorded from v.c. 1, 5, 58, 91, 102, 103, 106, and from Ireland.

(c) *Agglomerata*, var. nov. — *Planta robusta. Radix annua vel perennis. Caules nunc multi e basi orientes, nunc solitarii, plerumque contracti; ramuli saepius recto angulo abeuntes, et frequenter caule (centrali) longiores, et nonnunquam fere verticillati. Folia nitentia; radicalia rosulam formantia magis carnosae quam ea varietatis typicae, late ovata, integra vel obscure lobatula, basi vix cordata; superiora caulina saepe pro specie permagna late hastata, remote et obtuse serrata vel integra, in petiolum subalatum brevissimum subcomplanatum gradatim angustata, vel subsessilia, nervis utrinque obscurioribus. Racemi saepius vix elongati; flores (et fructus plerumque) arcte compacti, multi simul aperti. Silicula major quam eae varietatum aliarum.*

Plant annual or perennial, robust. Radical leaves many, forming a rosette, thick, fleshy, ovate, entire or obscurely lobed, scarcely cordate at the base, petioles rather short, stout. Leaves large, lower cauline leaves stalked similar to radical ones, or occasionally more distinctly 3-5-lobed, upper cauline leaves very shortly petioled or subsessile, lamina broadly hastate, serrate or entire, narrowing into the broad, flattish petiole. Main flowering stem stout, short, deeply furrowed, branches many, at right angles to

the main stem, forming a false whorl, sometimes ascending much longer than main stem. Flowering racemes sub-corymbose, scarcely lengthening, flowers and fruit agglomerated; lengthening of the racemes does sometimes take place, especially under shade conditions, but the shape of pod and leaf characters remain constant. Flowers opening several at a time, but in the early spring not opening at all, self-pollination taking place. Pods very turgid, distinctly truncate. Early flowers bright pink, later ones white.

I have records from v.c. 25, 58, 82, 83, 85, 101.

This is the common plant in the Forth area.

For the proper identification of a *Cochlearia* it is necessary to have freshly opened flowers, as the petals lengthen and change considerably in shape with age, those which have an abrupt narrowing from the limb to the claw as in *C. alpina* may, in the older stages, be almost spatulate in shape. This is least so the case, however, in *C. danica*, where they remain fairly constant in shape.

In the early part of the season, at least in Scotland, the flowers of *C. danica* in many cases do not open at all, and are self-pollinated by the long stamens. I have observed no flies visiting it in the Forth area, where var. *agglomerata* is the common plant. This absence of insects may be due to the exposed positions usually occupied by the plant there; but in none of the specimens which I have examined have I seen any trace of nectaries. In (c) *agglomerata* especially, I believe that self-pollination is the rule, as I find that the long stamens almost invariably dehisce before the flowers open; they are also bent over towards and pressed against the stigma, so that self-pollination can hardly fail to take place. The short stamens do not come to maturity until after the long ones have dehisced, and ultimately they reach almost an equal length and bend over towards the stigma likewise.

The plant is usually an annual or "winter annual," but var. (c) is, I think, sometimes perennial; certainly it is so in cultivation.

The pods of *C. danica* do not vary so much in shape as in some of the other species; they have a slightly truncate appearance when observed sideways, which distinguishes

them from those of any other British *Cochlearia*, and is most apparent in var (c) and (a), and least so in (b). This character is entirely lost in drying; in fact, identification by herbarium specimens of this genus is exceedingly unsatisfactory, many of the characters becoming obscure.

UTRICULARIA OCHROLEUCA, HARTMAN, AND U. INTER-MEDIA, HAYNE, AS SCOTTISH SPECIES.

By ARTHUR BENNETT, A.L.S.

The first record of *U. ochroleuca* as a probable Scottish species was in the "Annals of Scottish Natural History" for 1903 (p. 123). A further note on p. 250 has been wrongly referred to as editorial;¹ whereas Dr. Trail had not even seen the specimens, so that he could hardly suggest them as Scottish.

In the "Trans. Botanical Society of Edinburgh" xxiv. (1910), p. 61, the plant is again named.

These three references to certain specimens were made on the assumption that our specimens were similar in size to the original specimens of Hartman, one of which I possessed from the original locality, by the kindness of Dr. Nordstedt. On Dr. Glück visiting us in 1911, on showing him these specimens he at once assented to them, but also showed that other specimens much larger must also be so named, and in a few minutes I named some twenty specimens to all of which he agreed. It then became at once apparent that nearly all the specimens we had been naming *intermedia* were *ochroleuca*, and that *intermedia* was a rare species, in Scotland certainly, if not in England and Ireland.

Another difficulty that stood in our way was Neuman's idea that *ochroleuca* was a hybrid (i.e. *intermedia* × *minor*), and other specimens also were being given additional names, so it was not surprising the doubts felt.

In "Topl. Botany" (1883) and the Supplement, twenty-nine counties are recorded for *intermedia*. I possess specimens from seventeen of these, and in every case they prove to be *ochroleuca*.

¹ Williams, "Prod. Fl. Brit.," 6 (1909), p. 349.

In "Topl. Botany" the counties that are not vouched for by specimens (as *intermedia*) are:—81, Berwick (*U. vulgaris* only is given in Dr. Johnston's "Berwick Flora," 1829, p. 8, and from the description is that species); 92, Aberdeen S., "Northern Flora" (1836), p. 18; 100, Clyde Isles, "Nicholson Herb." (this is at Aberdeen); and 107, Sutherland E., Graham Excur., in the Supplement; 85, Fife, "Ann. Scot. Nat. Hist.," 1901, 103; 93, Aberdeen N., Trail; 95, Elgin, Druce. The others with "sp." noted can be seen in Mr. Watson's herbarium at Kew.

For the rest I have specimens, and they are all *ochroleuca*. The above counties will need specimens as vouchers as to which of the two occurs in them.

I give the original description of Hartman,¹ and synonyms:—*U. ochroleuca*, n sp.—Foliis distichis, laciniis planis plus minus parce vesiculiferis, labio corollae superiore palatum inflatum bis superante, calcare brevi conico a labio inferiore descendente. Jul., Aug.²

Praecedenti affinis (i.e. *intermedia*), a qua differt: herba tota multo tenuiore; vesiculis non solum ramis nudis, sed etiam foliis adhaerentibus; scapo rufescenti-brunneo; colore corollae pallidiore; longe alia forma, colore et directione calcaris. *U. intermedia* enim vesiculis inter lacinias fol. omnino destituta praebet scapum, bracteas calycesque semper laete viridia et calcar (subulatum, labio inferiori adpressum) ejusdem coloris ac corolla et saepissime ejusdem longitudo ac labium inferius."

U. brevicornis, Celak., "Oest. Bot. Zeit.," 1886, p. 253.

U. intermedia sub-sp. *ochroleuca*, Lange, "Hand. Danske Fl.," 1887, p. 524.

U. litoralis—*U. ochroleuca* × *intermedia*, Melander, "Bot. Not.," 1887, p. 175.

U. intermedia × *minor*, Neuman, "Bot. Not.," 1900, p. 65.

U. ochroleuca f. *microceras*, Strandmark! "Bot Not.," 1900, p. 66.

Distribution in Europe (no doubt incomplete): Bohemia; Germany (Black Forest); Tyrol; Norway, to 64° N. lat.; Finland; Sweden, in thirteen provinces from Halland to Vesterbotten.

¹ "Bot. Notiser" (1857), p. 30.

² The long detailed description I omit.

In Scotland (Watsonian counties): 72, 73, 74, 87, Perth Herb.! 88, 89, Perth Herb.! 90 and 91, Edinburgh Herb.! 96, 97, 98, 99, 101, 102, 103, 104, 105, Salmon Herb.! 106, 108, 110, 112. In all, twenty-one Scottish counties.

England: 6, 62 (*teste* Martindale), 69. From all these counties I have specimens, except where otherwise indicated. With regard to altitude, it occurs in 97 (*Macvicar* sp.) at 1000 feet; and in 88 (*Ewing* sp.) on Ben Lawers at 3200 feet. Dr. Nordstedt tells me it occurs in Blekinge at 15 met., and in Smoland at 250 met. In Norway at low levels—Nyman¹ refers the *U. ochroleuca*, F. Schultz, Herb. Norm., to *intermedia*, Hayne. The *U. intermedia*, F. Schultz, Herb. Norm., from the Vosages he puts to *ochroleuca*.

With regard to Neuman's calling it a hybrid, Dr. Nordstedt tells me that Neuman found only two fruits, and among sixty specimens he could not find any well-developed pollen. Dr. Nordstedt asks the very pertinent question, "Have you examined British specimens in this direction?" I have not, neither do I know of anyone else doing so. There are certainly differences among the many specimens I have seen that probably constitute a variety.

U. intermedia, Hayne.

On present knowledge this species is very rare in Scotland. I have seen a specimen in the Perth Herbarium from E. Perth gathered by the late Abram Sturrock. Another in the Edinburgh Herbarium (under the name of *U. minor*) from "Kincardine 1848," no collector's name.

In E. Anglia, in Norfolk especially, it is abundant, many stations being known, and in several it "covers many square yards";² in one at Honing, it is one of the half-dozen dominant species, and in four other places "it is extremely abundant"

The figure in "Eng. Botany, Supp.," t. 2489, is accepted by Hartman as representing the true *intermedia*, and the drawing (if correct) is certainly so.

In Sweden *intermedia* has a continuous distribution

¹ "Supp. Conspectus Fl. Europ." (1890), p. 259.

² Messrs. Clarke and Burrell *in litt.*

from Skåne up to Östersunds län, and in Finland is on record for twenty-three out of twenty-eight botanical provinces.

The account of the British species by Dr. Williams¹ is very full, in which he quotes Meister's opinion² that *U. major*, Schmid., and *vulgaris* are one species, with which I do not agree. Dr. Glück in "Deut. Bot. Geslls." (1902), p. 149. has a valuable contribution to the European species. Syme in "English Botany" gives 18 inches as the height of *U. vulgaris*, but Messrs. Burrell and Clarke³ found it on E. Ruston Common "just over 6 feet in height," and on Foulden Common with flower stalks 15 inches long. This is surpassed in *U. major*. I have specimens of the *f. gigantea*⁴ (sub *neglecta*) with flower stalks 20 inches long and with fifteen flowers, some of the pedicels $1\frac{1}{4}$ inches long. An interesting note on *intermedia* may be quoted from Messrs. Burrell and Clarke's paper:—" *Intermedia* in a normal state is always anchored by the branches which bear bladders only, either to the vegetation near the floor of the pools, that which margins them, or more rarely in the mud. As a consequence the hidden bladders and bladder-stalks are usually bleached and semi-translucent, contrasting vividly with the leaf stalks, which are of a characteristic yellowish-green."

I have to thank Dr. O. Nordstedt for kindly sending me the original paper of Hartman "De Svenska arterna af släktet *Utricularia*."

Dr. Williams' record of *intermedia* (l.c.) "north to Shetland, W. G. Beeby," will now be incorrect, as Mr. Beeby's specimens are the largest specimens of *ochroleuca* I have seen. They are 9 inches long, with bladder branches 6 inches, bladders $1\frac{3}{8} \times 1\frac{2}{5}$ of an inch, and leaves 1 inch long.

¹ "Prod. Fl. Brit.," 6 (1909), pp. 344-353.

² "Mém. Herb. Boiss.," n. 12, p. 31, 1900.

³ "Trans. Norf. and Norw. Nat. Soc.," ix. 2 (1911), p. 267.

⁴ Prahl, "Krit. Fl. Sch.-Holst." (1890), p. 173.

EXCURSION OF SCOTTISH ALPINE BOTANICAL CLUB, 1912.
By ALEXANDER COWAN.

The members of the Club met at the Killin Hotel, Killin, on Monday, 22nd July, for their Annual Excursion.

As the weather appeared fairly settled, it was arranged to visit Ben Lawers on the earliest possible day; and as the morning of 23rd July was fine, the members made an early start by motor to the foot of the mountain, commencing the ascent up the burn side leading to the Corrie. The weather was very warm during the earlier part of the day, but when the top was reached in the afternoon, it became much colder, and a rising breeze brought a considerable quantity of mist with it. Though these conditions made it unpleasant to remain long on the top, and no view could be had of the surrounding mountains, owing to the mist, the opportunity was nevertheless gratefully seized to cordially pledge (according to the custom of the Club) the health of its President. One of the features of the Corrie was the great show, on almost all the inaccessible ledges of the rocks, of *Myosotis alpestris*, Schmidt, which was seen in great abundance and in beautiful flower—while a plant with pure pink flowers was found by one of the party; and as the sun was shining brightly in the earlier part of the day, the members had no difficulty in finding large quantities of *Gentiana nivalis*, Linn., though they had failed to find it on their visit some years previously; but the absence of sunshine, to open the flowers on that occasion, probably accounted for their want of luck in finding the plant. *Saxifraga cernua*, Linn., was found very sparingly at the usual station near the top of the mountain; the following plants were also found:—

Thalictrum alpinum, Linn.; *Draba rupestris*, Br.; *Viola amoena* (T. F. Forst.), (in flower); *Silene acaulis*, Linn.; *Cerastium alpinum*, Linn.; *Arenaria verna*, Linn.; *A. sedoides*, Froel.; *Hypericum humifusum*, Linn.; *Rubus Chamaemorus*, Linn.; *Geum rivale*, Linn.; *Alchemilla alpina*, Linn.; *Saxifraga aizoides*, Linn.; *S. oppositifolia*, Linn.; *S. hypnoides*, Linn.; *S. cernua*, Linn.; *S. nivalis*, Linn.; *S. stellaris*, Linn.; *Sedum villosum*, Linn.; *S. roseum*, Scop.; *Epilobium alpinum*, Linn.; *Solidago*

Virgaurea, Linn.; *Saussurea alpina*, DC.; *Crepis mollis*, Aschers.; *Gentiana nivalis*, Linn.; *G. campestris*, Linn.; *Myosotis alpestris*, Schmidt; *Veronica scutellata*, Linn.; *V. saxatilis*, Linn.; *Salix herbacea*, Linn.; *S. reticulata*, Linn.; *Habenaria conopsea*, Benth., var. *alba* (2 plants); *H. viridis*, Br.; *H. bifolia*, Br.; *Tofieldia palustris*, Huds.; *Juncus triglumis*, Linn.; *Luzula spicata*, DC.; *Carex saxatilis*, Linn.; *C. flava*, Linn.; *C. echinata*, Murr.; *C. pulicaris*, Linn.; *Cryptogramma crispa*, Br.; *Blechnum Spicant*, With. (with all fronds forked); *Asplenium viride*, Huds.; *Polystichum aculeatum*, Roth; *P. Lonchitis*, Roth; *Polypodium alpestre*, Hoppe; *Botrychium Lunaria*, Sw.; *Lycopodium alpinum*, Linn.; *L. annotinum*, Linn.; *L. clavatum*, Linn.; *L. Selago*, Linn.

On the morning of Wednesday, 24th July, the members started to motor up Glen Lochay in order to botanise on Beinn Hescarnich, but after going about half a mile they found a notice-board closing the road to motors. There was nothing for it but to return, and it was at once decided to visit Creag-na-Callich and proceed thence to Cam Chreag, from which point the members proposed to descend to meet the motor on the road near Lochan-na-Lairige. Unfortunately, before any rocks were reached the party found themselves enveloped in a thick fog, so that it was quite impossible to ascend further. The wisest thing would have been to have retraced their steps by the way they came, but owing to the motor having been sent round by road to Lochan-na-Lairige, the party started by aid of map and compass to make their way as best they could in the thick fog in that direction. They found themselves in difficulties and in dangerous proximity to steep rocks more than once, but they eventually found their way to a point in the valley below the level of the fog, from which they could see the motor waiting for them about a mile away.

Though there was no actual rain, the fog was so laden with moisture that it gave one's clothing the appearance of being frosted all over, and in the circumstances practically nothing could be done in the way of botanising, though the following interesting plants were found on the lower ground visited:—

Thalictrum alpinum, Linn.; *Trollius europaeus*, Linn.;

Silene acaulis, Linn.; *Geum rivale*, Linn.; *Saxifraga aizoides*, Linn.; *S. oppositifolia*, Linn.; *S. hypnoides*, Linn.; *S. nivalis*, Linn.; *S. stellaris*, Linn.; *Sedum roseum*, Scop.; *Epilobium alpinum*, Linn.; *Solidago Virgaurea*, Linn.; *Veronica saxatilis*, Linn.; *Juncus triglumis*, Linn.; *Carex saxatilis*, Linn.; *C. capillaris*, Linn.; *C. binervis*, Sm.; *C. flava*, Linn.; *C. Oederi*, Retz.; *C. atrata*, Linn.; *C. pulicaris*, Linn.; *C. dioica*, Linn.; *Asplenium viride*, Huds.; *Polystichum aculeatum*, Roth; *P. Lonchitis*, Roth; *Polypodium alpestre*, Hoppe; *Botrychium Lunaria*, Sw.; *Lycopodium alpinum*, Linn.; *L. annotinum*, Linn.; *L. clavatum*, Linn.; *L. Selago*, Linn.

While the members were at breakfast on Thursday, 25th July, a thunderstorm came on, accompanied by torrential rain, and as the hills were covered with mist, botanising on them was out of the question. As the weather cleared somewhat by 11 o'clock, the members drove down Glen Ogle in order to examine the large beds of *Lastrea montana*, T. Moore, and other ferns growing in the neighbourhood, and especially on the slopes below the railway, where *Asplenium viride*, Huds.; *A. trichomanes*, Linn.; *Cystopteris fragilis*, Bernh.; *Carex canescens*, Linn.; *C. pulicaris*, Linn., and *Saxifraga aizoides*, Linn., were found. Several plants of crispate, brevilobe, and forked forms of *Lastrea montana*, T. Moore, were found. The remainder of the day was luckily fine.

On the morning of 26th July, the members botanised on the road leading to Lochearnhead, and in the afternoon on the road on the east side of Loch Tay, where *Hypericum hirsutum*, Linn.; *Circæa alpina*, Linn.; *Galium boreale*, Linn.; *Lysimachia nemorum*, Linn.; *Lastrea spinulosa*, Presl; *Cystopteris fragilis*, Bernh., var. *furcans*, and a pink-flowered *Prunella vulgaris*, Linn., were found. Though the morning was dull and threatening, with some mist on the hills, the afternoon turned out fine and warm.

The members returned home on 27th July.

Owing to the bad weather, only one complete day's botanising was possible, viz. the day spent on Ben Lawers, and although some good plants were there found, it was a great disappointment to the members to be unable to visit other mountains during their visit.

NOTES ON SCOTTISH PLANTS.

By G. CLARIDGE DRUCE, M.A., F.L.S.

The following notes have been prepared on plants collected from time to time in Scotland or observed on a long motor tour in it in 1912, when, owing to a severe attack of phlebitis, my walking powers were of the feeblest.

An asterisk marks a probable addition to "Topographical Botany." Several plants yet await a more detailed examination.

Castalia alba, Link,* var. *occidentalis*, Ostenf.—Near Dunkeld, Ostenfeld, see "New Phyt." (1912), 116; and "Rep. Bot. Exch. Club" (1911), p. 8.—On the Moor of Rannoch, Mid-Perth, 88.

Fumaria purpurea, Pugsley.—Near Tantallon Castle, 82.

F. Boraei, Jord.,* var. *britannica*, Pugsley.—Innerleven, Fife, 85.

Radicula islandica (Oeder), Druce, (*R. palustris*, Moench).—As a small form on the shores of Loch Leven, Fife, 85.

Polygala vulgaris, L.,* var. *Bullii*, Ostenfeld.—Inchnadamph. Sutherland W., 108.

**Sisymbrium altissimum*, L. Alien.—Abundant at Dundee.

Lychnis Preslii, Sekera.—Of this rare and interesting Bohemian *Lychnis* Miss Trower in 1910 found a solitary example. This year I visited the station but could find no other one. *L. dioica* is abundant there, and in varying degrees of hairiness, but the line of demarcation appeared to be well marked. The origin of this specimen still awaits an explanation. I may say that I was much too late in the season, and my walking powers too limited to say my search was exhaustive.

**Arenaria leptoclados*, Guss.—Near Aberfeldy, Mid-Perth, 88.

**Sagina apetala*, Ard.—Innerleven, Fife, 85.

S. nodosa,* var. *moniliformis*, Lange.—Stranraer, 74; Sands of Barry, 90; Brodick, Arran, 100; Elgin coast, 95; Applecross, 105; Golspie, 107.

Spergula sativa, Boenn.—Growing on drift-sand by Loch Rannoch, to which the seeds had been blown from a neighbouring oatfield nearly 100 yards away.

**Montia verna*, Neck.—Dunkeld, 89; Burntisland, Fife, 85.

**Melilotus officinalis*, Lam.—In a field near Perth, 89.

Astragalus danicus, Retz.—A form with extremely small leaflets (3 mm.) occurred at Carnoustie, 90, which culture may prove to be a variety.

Vicia sylvatica, L., var. *condensata*, Druce, in the classic locality on the shingle near Port William, Wigtown, and I also found it on the Antrim coast at White Sand Bay. In cultivation after three years from seed it still retains its characteristics in my garden.

Alchemilla alpestris, Schmidt.—Near Port William, 74; Gatehouse of Fleet, 73; near Dumfries, 72; Cortachy, etc., Forfar, 90; Romano Bridge, Peebles, 78.

Prunus spinosa, L.,* var. *prostrata*.—Branches very spinous, completely prostrate, bearing very numerous and rather large fruits. On the shingle near Port William, 74.

Cotoneaster microphylla, Wall. Alien.—Seedlings at Abbotsford.

**Crataegus oxyacanthoides*, Thuill.—Near Kirriemuir, 90; good-sized bushes but having the appearance of being planted.

Parnassia palustris, L.,* var. *condensata*, Wheldon et Travis.—Sands of Barry, Forfar, 90.

Pimpinella Saxifraga, L.,* var. *poterriifolia*, Wallr.—Tantallon Castle, 82.

**Solidago serotina*, Ait.—Alien, North America. Galashiels, Selkirk, with Miss I. M. Hayward in 1910.

Arctium nemorosum, Lej.—Gatehouse of Fleet, 73; near Port William; and a form with pure white florets, near North Berwick, 82.

**Taraxacum spectabile*, Dahlst.—Clova, 90.

**Lactuca muralis*, Fres.—Between North Berwick and Dunbar, 82.

Calluna vulgaris, Hull,* var. *Ericae*, Asch.—Glen Doll, 90.

**Veronica Anagallis*, L., *vera*.—Near Kirkcinner, 74; Rescobie, 90.

Euphrasia brevipila, Burn. et Gremli.—Glenluce, 74; Gatehouse of Fleet, 73; Ettrick Bridge, Selkirk, 79; Dollar Law, Peebles, 78; Dunkeld, 89; Sligachan, Skye, 104; Kinlochewe, 105; Clova, 90; Moor of Rannoch, Perth, 88.

E. curta, Fries.—Sligachan, 104.

E. stricta, Host.—Drummore, Wigtown, 74; Ettrick, Selkirk. :

E. gracilis, Fries. —Glen Doll, 90, with a hybrid probably with *brevipila*.

E. Rostkoviiana, Hayne.—Kinloch Rannoch, 88.

Melampyrum pratense, L., var. *hians*, Druce.—Near St. Anne's Bridge, Dumfries, 72.

Bartsia Odontites, Huds.,* var. *verna* (Reichb.). —Balgavies, 90.

**Mentha rotundifolia*, Huds. —Near Duns Bridge, with Mr. and Mrs. Corstorphine. A distinct variety from the common British form.

**M. spicata*, L.—Gatehouse of Fleet, 73.

M. longifolia, Huds.—Abundant near Glen Ogilvie, etc., Forfar, 90. A distinct variety, not *mollissima*, which awaits a name. Also a very distinct variety if not a distinct species, and one I have not noticed previously in Britain, at Kirkinner, Wigtown, 74.

M. piperita, Huds.—Rescobie, Forfar, 90.

**M. aquatica* × *spicata*.—A curious Mint, with the appearance of *gentilis*, but having hairy pedicels, occurred between Kirkinner and Whithorn, Wigtown, 74. This also is probably an undescribed British form.

**M. rubra*, Sm —Near Melrose, 80.

Scutellaria galericulata, L., var. *pubescens*, Benth.—Identical with specimens I gathered in the Mull of Galloway, and having a distinct facies of their own. I have little doubt it is a distinct variety deserving of a special name. These grew on the shingle near Port William, Wigtown, 74. I describe it as var. *littoralis*.

Utricularia intermedia, Hayne. —Rescobie, 90; Sligachan, Skye; near Loch Lomond, 97; Loch of Drum, 91; Culdoch, Kirkcudbright, 73; Loch Breack, E. Ross, 106.

U. ochroleuca, Hartm.—Moor of Rannoch, 88, 97, 98.

Plantago maritima, L.,* var. (*P. alpina*, Williams).—Sgur Alaster, Skye, 104.

Atriplex glabriuscula, Edmonst. (*A. Babingtonii*, Woods, var. *virescens*, Lange).—Loch Ryan, 74; near Montrose, 90, with Mr. and Mrs. Corstorphine.

**Polygonum heterophyllum*, Lindman.—Stranraer, 74; Gatehouse of Fleet, 73; Moffat, 72; Peebles, 78; Selkirk, 79; St. Boswells, 80; Duns, 81; North Berwick, 82; Roslin, 83; Linlithgow, 84; Kinross, 85; Stirling, 86; Callander, 87; Lawers, 88; Dunkeld, 89; Carnoustie, 90.

**P. aequale*, Lindman.—Moffat, 72; Kirkcudbright, 73; Glen Luce, 74; Peebles, 78; Selkirk, 79; Melrose, 80; Duns, 81; North Berwick, 82; Portobello, 83; Linlithgow, 84; Kinross, 85; Stirling, 86; Callander, 87; Weem, 88; Perth, 89; Carnoustie, 90; Grantown, 96; Ullapool, 105.

**Rumex obtusifolius* \times *nemorosus* = *R. Duffii*, Hausskn.—Perth, 89.

**Ulmus glabra*, Miller.—Near North Berwick, 82; near Kinnaird Castle, 88; Callander, 87. Planted.

**Castanea sativa*, Miller. — Glen Luce, Wigtown, 74. Planted, of course.

Betula verrucosa, Ehrh.—North Berwick, 82; Dalmeny, 83; Linlithgow, 84; Bridge of Allan, 86.

B. pubescens, Ehrh.—Trossachs, 87; Dunkeld, 89.

**Populus canescens*, Sm.—Between Dumfries and Moffat, 72; Gatehouse of Fleet, 73; Strathmore, 90. Planted doubtless.

**P. deltoides*, Marsh., var. *serotina*, Hart.—72, 73, 74, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90.

**P. candicans*, Ait.—Near Raehills, Johnstone, 72; Castle Douglas, 73; near Aberfeldy, 88; North Berwick, 82; near Grant's House, 81. Planted.

**Sparganium neglectum*, Beeby.—Rescobie, with the Brit. Association Excursion, 90.

**Juncus ranarius*, Nees.—Loch Leven, 85; Carnoustie, Forfar, 90; Boat of Garten, 96; Inverlael, Kishorn, W. Ross, 105; Golspie, 107.

Scirpus caespitosus, L.,* var. *germanicus* (Palla).—Moor of Rannoch, 88; 98.

Carex muricata, L.—With small fruit, approaching *C. Leersii*, Kinnaird Castle, 88.

Festuca rubra, L.—Tantallon Castle, 82.

NOTE ON *ARAUCARIA BIDWILLII*, HOOK.

By Professor GIOVANNI ARCANGELI.

I believe it will be of interest to call attention again to a specimen of this species growing in the Botanic Garden of Pisa.¹ This specimen, obtained from the nursery of M. Scarlatti at Florence, was planted in the place named Orto Nuovo by the late Professor T. Caruel in 1872. This plant, when transferred to our Botanic Garden, probably was not more than twelve years old, and will now be fifty-three years old. Though the stem of this plant was three times cut off near the top by wind, it has always restored its summit quite well, and now its habit is very imposing, and resembles that of an *Abies*, the stem being clothed by branches disposed in numerous whorls from the base to the top. At the time of my former publication, the stem of this plant was 12 m. high and 0.35 m. in diameter; at present it attains a height of 16 m., and a diameter at the base of 0.54 m., growing in thirteen years about 4 m. in length and 0.19 m. in thickness. It thus becomes clear that the ground of our garden is very suitable for the cultivation of this plant, which not only grew vigorously, but supported the heat and dryness of the summer, as well as the cold of the winter, down to -8° C.

In the year 1911, we began to observe on our plant, in the spring, some flowers, probably born in the preceding year. The flowers appeared on the branches near the top of the tree, and were amentiform, in small quantity, and female, bearing ovules but without stamens. Therefore we infer that this plant has attained its puberty about its fifty-second year. At the end of September the flowers were changed into bulky cones nearly 25 cm. long and 15 cm. broad. Each cone was composed of the superior part of a branch, swollen and oblong, bearing numerous appendages, which on maturity fell down with the seeds included within. These appendages have a complex nature, which is not easy to explain. Each appendage is formed by a cone-scale, placed in the axil of a bract, but almost completely adnate

¹ "Buletino della Società botanica italiana," Nov.-Dic. 1899, N. 9-10, p. 262.

to it, and variously judged by morphologists. R. Brown held that the cone-scale was formed by two open carpellary leaves or ovuliferous leaves, while by other authors (A. Braun, etc.) it was interpreted as a placental protuberance of the bract bearing the ovules. Professor Parlatore and others explained the cone-scale as a floral branch born in the axil of the bract. Professor Delpino held that the cone-scale was an ovuliferous member formed by coalescence of the two margins of the bract, according to his theory on Antispermia. In a short note presented to the Botanical Congress at Paris in 1878, I expressed the opinion that the cone-scale of Coniferales¹ would be a member intermediate between the branch and the leaf, which I named Cladophyllum, corresponding to the Cladodium of Kunth. The cone-scale had been also called Synphyllodium² by Celakovsky, but this name seems to me not suitable, because the term Phyllodium is appropriated to the case of a petiole imitating the blade of a leaf, and the cone-scale is not formed by stalks of leaves only, but also by a part of an axis or branch. Some of these cone-scales in our plant presented a seed in the middle part, but these seeds, though furnished with a hard and woody shell surrounding a reddish tissue, were without embryo or empty. As we have not in our garden a male specimen, it was not possible to obtain seeds with embryos and capable of reproduction.

It is interesting to remark that near this female specimen grows a male plant of *Araucaria brasiliiana*, A. Rich., more than forty years old, which flowers every year, but the sterility of the seeds obtained would show that the pollen of that plant is not able to fertilise our *A. Bidwillii* and produce a hybrid; however, it is not prudent to judge by a single case in so difficult a question. As this pollen was perfectly developed and fertilised the female flowers of another specimen of *A. brasiliiana* placed at a little distance, with production of numerous progeny,

¹ "Congrès intern. de Botanique tenu à Paris," 16-24 août 1878, Paris, 1880, p. 38.

² Celakovsky, L. J., "Neue Beiträge zum Verständniss der Fruchtschuppe der Coniferen" ("Jahr. für wiss. Botanik, begr. von Professor N. Pringsheim," xxxv., Leipzig, 1900, pp. 407-448).

we must infer that the failure is not due to a bad structure or disease of the pollen.

M. B. Chabaud, in a publication of 1882,¹ mentions a specimen of *A. Bidwillii* growing in the garden of the Duke of Vallambrosa at Cannes. The stem of this specimen had reached a height of 12 m. and a diameter of 0.50 m. This plant bore fruits in that year, but these were sterile.

In the same year, 1882, a female specimen of this species flowered in the Botanic Garden of Naples. We keep in our collection some cone-scales of this plant, but with sterile seeds.

Specimens of this species were subsequently observed to be fruitful in 1884 at Palermo, at the villa of the Prince of Trabia and Butera,² and about this time also in South France and Algeria.³

The fruiting of another specimen of this species was announced by Professor C. Naudin in the garden of the Villa Thuret at Antibes in 1893, but here also the seeds were sterile.⁴

In the Botanic Garden of Palermo this plant grows perfectly and bears fecund fruits, which, according to Professor Borzi,⁵ ripen in fifteen months. Another plant of this species is growing in the Botanic Garden of Catania in Sicily. This specimen is monoecious and able to bear fecund seeds, as appears from the "Index plantarum quas Hortus bot. R. Universitatis catinensis pro mutua commutatione offert, 1898," where the fecund seeds of this plant are quoted.

The seeds of this species are also offered in the "Index seminum Horti botanici Universitatis olisiponensis anno 1911 collectorum" (p. 29), and I have asked for them, but I have received only a sample with the kernel completely perished and quite unable to germinate.

¹ Morren, Ed., "La Belgique horticole," 1882, p. 213.

² "Bull. della Società toscana di Orticoltura," 2^a ser., vol. i., 1886, p. 241.

³ Heckel, E., "Sur le Bunya-bunya (*A. Bidwillii*, Hook.), et son acclimatation en Algérie," etc. ("Revue Sc. nat. appl.," 1891, 2^e sér., 38 année, Paris, pp. 280-295).

⁴ "Bull. della Società toscana di Orticoltura," 2^a ser., vol. viii., p. 316.

⁵ Borzi, A., "Biologia della germinazione dell' *A. Bidwillii*, Hook." ("Contr. Biol. veg.," iii., 1895, pp. 355-373, tav. xvi.).

Some specimens of this species are also growing at Rome, near the railway station, in the Garden of Pincio, at Villa Doria Pamphily, and elsewhere. The specimens near the railway station are 19 m. high and 0.61 m. in diameter at the base; likewise, a splendid specimen cultivated at Villa Pamphily last year was fruitful, but with sterile seeds. Evidently the dioecious nature of this species is the cause of its frequent sterility, and the parthenocarpous condition of its fruits.

Meanwhile, as it would be very interesting to settle for this species the possibility of cross fertilisation with *A. brasiliانا*, in the last spring we have dusted the branches of the upper part of our specimen with the pollen of *A. brasiliانا* above mentioned, appending also the floriferous branches of this specimen to the branches of the other, for facilitating the crossing between the two species, and now we are waiting the upshot of this experiment.

Moreover, we suggest that it would be very profitable to promote the culture of this species in Italy and in other temperate climates, not only as an ornamental plant for its persistent and pretty foliage, but also for the products which it may supply (timber, seeds, etc.).

A NEW PLEUROSPERMUM. By W. G. CRAIB, M.A.,
and W. W. SMITH, M.A.

Pleurospermum amabile, Craib et W. W. Sm. Sp. nov.

Species affinis *Pleurospermo densifloro*, Benth. et *P. Brunonis*, Benth.; foliis floribusque persimilis, bracteis obovatis vel suborbicularibus permagnis cum foliis imbricatis pulcherrime purpureo-suffusis distinguenda.

Planta erecta 8–20 cm. alta, radice crassâ praedita, basi ad collum vaginis foliorum marcidorum induta. Folia basalia 1–2, vaginâ 3–6 cm. longa, petiolo 1–2 cm. longo vel nullo praedita; lamina ambitu ovata, 3–4-pinnata, glabra, ad 5 cm. longa, segmentis ultimis setaceis 1–2 mm. longis; folia caulina plura basalibus subsimilia, laxè imbricata, vaginâ circ. 3 cm. longâ, fere orbiculari vel late oblongâ, tenuiter membranaceâ, purpureo-suffusâ, petiolo nullo,

laminâ circ. 1.5 cm. longâ 3-4-pinnata, saepe fere obsoletâ; folia gradatim in bracteas obovatas vel suborbiculares transeunt. Bracteae ± 12 , cum foliis imbricatae, 3-5 cm. longae, inflorescentiam fere velantes, saepe laminâ minimâ 2-3-pinnatâ in mediâ apice late rotundatâ positâ praeditae, pulcherrime purpureo-suffusae et saturatius purpureo-striatae, margine erosae. Radii primarii 20-50, ad 4 cm. longi. Bracteolae ± 12 , variae, obovatae, nunc oblanceolatae, apice rotundatae, erosae, nunc lanceolatae, apice longe acuminatae vel apiculatae, 6-7 mm. longae, albido-membranaceae, purpureo-suffusae, costâ saturate purpureâ pererratae. Radii secundarii 15-30, circ. 3 mm. longi. Petala obovata, circ. 1 mm. longa, albida, purpureo-suffusa; antherae purpureae; discus magnus; fructus immaturus.

East Himalaya.—At Chulong, in the Chumbi Valley, Tibet, at an elevation of 15,000 feet, August 1912. Coll. Rohmoo Lepcha, No. 207 in Herb. Edin.

WILLIAM GARDINER, AUTHOR OF "THE FLORA OF FORFARSHIRE" (1848). By ALEXANDER P. STEVENSON.

In the "Dundee Courier" for 16th June 1852, a paragraph appeared which gave an account of an exciting event in Dundee on the previous day. An equestrian company had placarded the walls of the town with bills intimating a "grand entry," in which a car drawn by ostriches was to take part. The visitors were expected from Perth, and waiting crowds filled the Nethergate and the Perth Road, while straggling groups had even found their way to Invergowrie. Most of the spectators were doomed to disappointment. The company had arrived the previous evening, and only made a hurried run from their quarters at Hobb's Stables in Castle Street, along the High Street and Nethergate, turning up South Tay Street to the West Port, and then passing via the Overgate to their stables again.

In their passage eastwards through the Overgate, a bit of tragedy was mingled with the comedy. A weakly man, keen to see these unfamiliar ostriches, was helped from his

sick-bed by friendly hands, and from the window of his room saw the strange birds for the first and last time. The ruling passion in this lover of nature was strong to the end. The next issue of the "Courier" intimated the death of the invalid sightseer—William Gardiner—of whom it is proposed to give a sketch.

This Overgate of Dundee we all know, more or less. It is not the likeliest spot for the birth and upbringing of a naturalist and poet, and yet the whole life-history of William Gardiner was practically developed in or near this unpromising thoroughfare.

He was born in a building which still stands at the north-west corner of South Tay Street. At the opposite corner of North Tay Street is the house in which for many years he lived and wrote the greater part of those manuscript magazines—now in the Lamb "Old Dundee" collection—which were the outcome of his fertile brain and evidence of the skill of his deft and willing fingers. He served the years of his apprenticeship to an umbrella-maker, in a shop at the Overgate end of Barrack Street, and worked as a journeyman in another shop between Thorter Row and Tally Street. A little to the west of South Lindsay Street, just opposite St. Paul's U.F. Mission Buildings, is the small shop where he offered for sale pamphlets and periodicals, and disposed of, as well as prepared, his specimens and portfolios of British plants. A few yards to the west of this is Spence's Close, where his happy married life was spent, where his dearly loved wife died, and where in shadow and gloom the days of his own pilgrimage were ended. It neither is, nor was, an ideal setting for a naturalist's life, and yet in Gardiner's earlier days it did not lack redeeming features. If the houses were small and dingy, and the street narrow and dirty, still, on the other side of the buildings, away from the street, there were bits of garden in which flowers bloomed, and fruit trees grew and flourished. Gardiner writes at times of what he saw from his windows—insects fluttering in the flower beds; valerian growing luxuriantly, and cats, as is their wont, getting quite wild over it—he wants to know the reason why? Many other observations are recorded which show that even in these unlikely quarters he was

never very far away from that world of living, growing, and breathing things, which was meat and drink to his nature. And then there was the Windmill Brae on the north side of the Overgate, stretching northwards to the Ward Road or Meadows, of which the only survival now is a "Windmill Close" in the Overgate.

The Brae is long since quarried away, and the quarry which in the younger days of some of us was the home of shows and hobby-horses, is now quite obliterated by buildings in which the "Courier" offices lately occupied a principal part. The ground, in the earlier years of last century, was a favourite site for gardens, and gave opportunity for the cultivation of botanical and horticultural tastes. One William Lennox, a working shoemaker, had a garden there, and cultivated, with extraordinary success, the plants he gathered in the fields and woods of the neighbourhood. This Lennox, according to a note by Gardiner in "Loudon's Magazine of Natural History," was the first to breed the siskin in captivity, and he figures in Decandolle's "Géographie Botanique Raisonnée" (1855) as having introduced the showy *Mimulus luteus* into this part of the country. Mr A. C. Lamb in his "Old Dundee" speaks of the Windmill Brae retaining its rural character so long that in 1820 it was still a favourite place for strolling on summer Sabbath mornings. In a herbarium belonging to his uncle Douglas Gardiner, which was formed in 1813, and came into Gardiner's hands (fragments of it being still extant), specimens were included which either grew wild or were cultivated on this same Windmill Brae. In that old herbarium are specimens of plants given to Gardiner's father and uncle by George Don of Forfar, with whom both men were acquainted, and had occasionally botanised together.¹ And this leads one to associate Gardiner with a sort of apostolic succession—the younger man maintaining and developing the tastes and tendencies of his forebears. He was born in this Overgate, 13th July 1808—not 1809, as has generally been stated. He himself writes à propos

¹ Visiting George Don at Forfar, Gardiner's father and uncle were much attracted by some fine plants of *Hippuris vulgaris* in Forfar loch. How to obtain specimens was giving them some consideration, when Don solved the problem by simply walking into the loch for them!

of the Bell Rock: "The foundation-stone of the Bell Rock Lighthouse was laid on 10th July 1808, *three days before my birth.*" His father and mother were not married, and according to all accounts the mother had a hard struggle to maintain him in his earlier years. Among other ways of earning a living, she used to "hawk" crockery for sale, and frequently she called upon her customers with her basket of wares upon one arm and bearing her boy on the other. Not much is known of her. It is reported that she was somewhat ready with her tongue, and there are hints in some of his father's verses which would seem to bear this out.

In any case, she was a good mother to her boy, and did not spare herself for his upbringing, and he certainly had a great regard and affection for her. In after years the story was current that, out of consideration for her, he declined an appointment at Kew Gardens, offered him by his friend and helper in many ways, Sir William Jackson Hooker, which would probably have given him a higher place in the botanical world than a mere local plant collector could ever hope to obtain.

Ultimately the mother was able to start a small shop for the sale of her wares and the purchase of waste, and this same shop in the Overgate was in time occupied by Gardiner himself.

The father of Gardiner (also William, so that for many years the son's signature was William Gardiner, Jr.) was a man of considerable ability. A weaver to trade, he sought a change of occupation in the spring and summer months by doing garden work. He must have been a wonderfully well-read man for his time and station. He was a keen botanist, and knew a good deal about natural science. At the meetings of the "Gleaners of Nature"—a Society of which his son was secretary—the "Transactions" (in MS.), extending from 16th July 1828 to March 1830, show that the elder Gardiner was ever ready to answer the "kittle" questions proposed for solution—chiefly by his son. Among these the following may be taken as samples:—"Why does friction produce heat? Why does extreme cold and heat cause stupor and inclination to sleep? Why does the sun appear larger at his rising and setting than at

his meridian? I have read in a respectable work, that if snuff be thrown upon the back of a toad or frog it will instantly die: is this actually the case, and if so, what is the reason why?"

I am not sure the answers given would altogether commend themselves to modern scientific knowledge. It is pleasant, however, to think of these humble "Gleaners" wrestling with such questions, and then to find, as their minute book quaintly puts it, that "highly satisfied with the proceedings of the evening, the members harmoniously retired."

In "The Flora of Forfarshire," Gardiner gives the habitats of some of the rarer plants on the authority of his father, while many references are made to his knowledge in the manuscript magazines, of which I shall speak further on. One plant is interesting, because when Gardiner, senior, came across it "on the banks of the River Dean, near Drumkilbo," his companion was "the poet Hedderwick." There were two brothers of that name with whom the elder Gardiner was intimate, and to whom he addressed poetical "epistles."

These poets and their works are forgotten now, although they appear in Alan Reid's "Bards of Angus and Mearns." They are notable, however, as the ancestors of a family which has done much for Scottish poetry and literature in the western metropolis of Scotland—I refer to the Hedderwicks of the "Glasgow Citizen."

Gardiner, senior, loved both the men and their verses, and tells them:

"I soon shall break loose from this gaol that I lodge in,
To breathe the fresh air in the How of Strathmore,
And soon o'er Kinpurnie¹ ye'll see me come trugin',
To gie ye my hand and my heart as before."

Two small collections of poems were published by William Gardiner, senior; one of forty pages in 1815, and

¹ Kinpurnie, a hill to the south-east of Newtyle, on the summit of which are the remains of a tower built by the Hon. James Mackenzie of Belmont, Lord Privy Seal, in the last quarter of the eighteenth century. Using it as an observatory, his lordship spent much time here in astronomical researches, in which he took great interest. His frequent companion was Dr James Playfair, the parish minister of Newtyle and Meigle, afterwards (1799) Principal of the United College of St Andrews.

another of fifty-six pages in 1818. The first was dedicated "to a' the lovers of a Scottish Sang."

"I hae nae hopes a laurel to obtain—
 Sic thoughts in me wad doubtless be but vain.
 I ne'er was taught, nor polished at the school,
 What hae I then, but simple Nature's rule?
 My warks are chiefly in my mither tongue,
 Then critic blades hae mercy wi' your rung
 An' dinna thrash me tho' I lat a stammer,
 For ane like me kens little o' your grammar."

While none of the "poems" rise to any high level, they are full of manly common sense and breathe a kindly humour. Unmistakably modelled on the styles of well-known Scottish poets, they yet have a distinct individuality and show not only a wonderful gift of expression but also a lively sense of rhyme. Apart from the humorous epistles, the following lines of a more serious nature may be quoted, both as showing what is meant by his verses being modelled on well-known poems, and as a picture of the lot of too many of the workers in these "good old times":—

A BARI'S SOLILOQUY.

Why am I thus, with never ceasing toil
 Opprest and harass'd every passing day?
 Why, Fortune! why thus never deign to smile?
 Why let pale Poverty bedim each ray,
 That might enliven me and make me gay;
 Or rouse my drooping soul that's almost spent?
 What riches dost thou lavishly convey
 To those who live but only to torment
 The poor, and shut their ears to every sad complaint.

But, happy thought—thrice happy to my soul!
 That mighty Nature shows no more respect
 To those who rudely reign without control,
 And virtue's precepts basely do neglect;
 Tho' rob'd in pomp—dare they, dare they expect,
 When loud tremendous thunders roll on high,
 That Nature should their lordling souls protect,
 Or shield them when terrific lightnings fly,
 More than the poorest wretch that crawls beneath the sky.

Not stately mansions, nor the gilded spire,
 Shall screen them, should the dreadful whirlwinds blow:
 Ignoble Souls! why do they then aspire
 To crush their fellow-worms and give them woe;
 When neither gold nor ostentatious show
 Can save them from the tempest's angry roar
 More than the slave, who meanly gives the bow
 To pampered equals—sure they are no more:
 Great Nature proves the fact—and Nature I adore.

In one of the epistles in the booklets, referring to his brother Douglas Gardiner, he says of him :

Ye say the earth is like a ba',
The moon an' starns are warlds sae braw ;
Whare did ye git sic jargon-jaw,
Ye magic man ?
The best book ye could read ava',
Says ye are wring.

This Douglas Gardiner, as other verses show, was a man with many scientific tastes and abilities, and had a good knowledge of the sciences as known in these times. I am told that, among other occupations, he was consulted as a herbalist. He possessed a microscope and an air-pump ; used electric apparatus of some kind ; knew a good deal of chemistry ; and had an excellent knowledge of plants, both as to their identification in the field and garden and their essential properties as applied in the arts and in medicine. Several papers by him, which appear in his nephew's "Botanical Repository," indicate an acquaintance with historical botany and physiology rather exceptional, one would think, for a man in his station : and altogether he impresses me as a man of culture, about whom I would like to know more than can now be known. He was secretary or curator of the Dundee Rational Institution, which was founded in 1811 "to facilitate the acquisition of literary and scientific knowledge, and to increase the pleasure which results from that acquisition."¹

The Institution survived till 1820, and if we may judge from the list of museum specimens, scientific apparatus, and valuable books offered for sale on its dissolution, it had something to show for the years of its existence. Among its active members were Lord Ivory in his younger days ; the parish minister's son, J. G. Macvicar, afterwards parish minister at Moffat, and well known for his work in philosophy ; Henry Stephens, author of the "Book of the Farm" ; and among many other notables, William Lyon Mackenzie, whose activity in the Canadian rebellion of 1837 induced the Government of that period to offer a reward of £1000 for his apprehension, and won for him the appellation of that "traitor Mackenzie" from Lord John Russell. I have treated Gardiner's father and uncle

¹ "Scots Magazine," 1816, p. 169.

at some length, because they were interesting characters themselves, and had a considerable influence, both directly and indirectly, upon their younger relative. In his early years, however, his mother had to care for him as best she could. He evidently got some little schooling, was taught to read and write, and after that, the rest lay mainly with himself. In his habits and tastes he seems to have been as troublesome to his mother and others as Smiles' "Tam Edward." The story has been told that once, when having a game at "bools," and finding that his favourite "plunker" had got inside the lining of his jacket, he got a companion to put his hand into the opening in his pocket and search round the corner for the missing "bool." With a yell the boy withdrew his hand in great consternation. "What's the matter?" queried the assembled group of players, as they gathered round the frightened boy, who was holding his hand as if bitten by a snake. "The matter! I dinna ken, but there's something queer in Will Gardiner's pouch." "Man, fat are ye roarin' at, it's jist a kailie," said Gardiner, who had got the "plunker" now himself, and produced along with it a number of wriggling kail-worms and snails which he was carrying home to watch at his leisure.

During his earlier years he seems to have been fond of getting into the open country and seeing Nature in all weathers. His apprenticeship, at the age of ten years, to Mr. Barclay, umbrella-maker in Barrack Street, while it naturally confined him more closely during the working-day, only stimulated his ardour in using the time he could call his own to the best purpose. A second-hand copy of the vegetable section of Berkenhout's "Synopsis of the Natural History of Great Britain" (1789), came into his hands, and this he found of great use to him, so much so, that in after years he said that by it "he was enabled to identify all the plants in the neighbourhood." A ragged copy of Ray's "Synopsis of British Plants" was useful in supplementing Berkenhout. Side by side with these natural history studies and rambles, he was devouring all the books he could come across; and it is really surprising to find both from actual quotations and from little tricks of style in his earlier writings, what a wide field his reading must have covered.

An influence and help all for good came to him from a humble tailor in the Scouring Burn. This was William Jackson, another interesting personality of these times. Jackson was a good all-round naturalist, although devoting himself principally to ornithology. He had in his house an extensive natural history collection, prepared by himself. There is in existence a copy of a quaint circular issued by him, in which he offers "Private instruction in the best methods of preserving and mounting animals for cabinets and museums," which "would be particularly useful to those who were going abroad."

In after years Jackson became curator of the Watt Institution Museum, and after his death was succeeded there by his son, who was an even more able naturalist than his father, but who died very young.¹ The elder Jackson had an excellent library, and to this Gardiner had free access; and it is pleasant to know that what the father did for Gardiner, he in his turn did for Jackson's son. In a boyish letter I have seen, the younger Jackson writes Gardiner, telling him how much pleasure he was receiving from the botany he had taught him. The Jacksons were Unitarians, and through them Gardiner came in contact with the Rev. William Smith, the first regular Unitarian minister in Dundee since the able and unfortunate Thomas Fyshe Palmer in 1793.² Mr. Smith was well versed in natural history, and had a special fondness for work with the microscope. He became an F.L.S. in 1847, and when he died in 1857 was Professor of Natural History in Queen's College, Cork. He is well known by his "Synopsis of the British Diatomaceae," published in 1853 and 1856,—“a striking memorial of his industry in collecting, and patience in determining, objects so minute, but at the same time so curious and interesting.”³ The plates in his book contain figures of nearly 400 species, and are beautifully engraved—the materials from which he worked being now in the British Museum.

¹ The younger Jackson was elected an Associate of the Botanical Society of Edinburgh on May 14, 1840.

² Thomas F. Palmer, Fellow of Queen's College, Cambridge, who is mentioned in Boswell's "Life of Johnson," and whose name is inscribed on the monument in the old Calton burying-ground to the "Political Martyrs" who suffered for their early efforts in the cause of reform.

³ "Proceedings Linnean Society," 1857-58.

It will thus be evident that Gardiner did not lack encouragement to develop the tastes he was manifesting, and both his father and uncle were ready to help, especially the latter. In one of his early notebooks (1827) he pictures a character which was probably himself at that period: "One much given to study and meditation, which sometimes exercises him even in company, so that he appears absent, and is often thought dull and spiritless, and totally deficient of talents for consideration by those who are unacquainted with the cause. Such a one enjoys himself most in such a walk as I had this morning—the mildness of the vernal air, the majestic serenity of the sky, the colouring fields, the first gems of spring bursting into new life, the blue tranquil bosom of the river and the far-extended prospects kindle within his breast those tapers whose flames warm the soul with delight, and diffuse around the noblest ideas of the Mighty Creator."

By and by, however, the young man overcame his shyness and desire for isolation, coming in contact with kindred spirits, who took a like interest with himself in the aspects and things of that world around them which lay outside "the road of toil, with their grave cut across," otherwise their only outlook. These working men, existing as best they could upon the wages of a present day mill-boy, were living the lives of philosophers and thinkers. To note the subjects with which they were familiar, and the style with which they could write about them, reveals a state of plain living and high thinking, which one fears is rare in these more favoured times. It suited Gardiner's taste to write out transcripts of passages and papers he had come across in his reading, and circulate these among his friends. The extent of his industry in this direction is something marvellous. Mr. A. C. Lamb, in the "Bibliography of Dundee Periodical Literature," published in "Scottish Notes and Queries" (vols. iii. and iv.), gives a lengthy list of those various manuscript magazines, from the "Literary Scrap Book or Prose and Poetical Miscellany," issued in 1826, to the "Botanical Repository" in 1831, which, after absorbing a separate publication, the "Zoological Repository" in 1832, was carried on as the "Amateur Naturalists' Repository and Journal of Natural History" till November

1835. Mr. Lamb possessed most of these magazines, and they now form part of the "Lamb Collection," gifted to the Dundee Free Library by Mr. Edward Cox. In addition to the botanical and other natural history papers written by Gardiner for these journals, he also contributed many poetical pieces. These are somewhat stiff and artificial to start with: Ceres, Flora, and Zephyrus, and others of the "deities of a creed outworn" are rather prominent; but, as the days and years go on, we get the true "wood-notes wild"—full of charm and freshness. A page from his Journal of 5th May 1827 may be quoted:—

"I again forsook the arms of slumber for the more pleasant enjoyment of breathing the salubrious air on the Law-hill, and there marking the soft beauties of early morn. On the hill I found a small Red Vetch and a great quantity of Grain-rooted Saxifrage.

GENERAL SKETCH.

The mornin' in the east appear'd,
 An' waukrife cocks began to craw,
 I left my couch and blythely steer'd
 My course to yonder flowery Law.
 The blackbird sang in Logie's shaw,
 An' little larks wi' lively glee
 Chae'd the dun clouds o' night awa',
 An' hail'd the risin' day wi' me.

Frae ilka gowden whinny fell
 The linties pour'd their am'rous lay,
 An' saft and soothin' was the swell
 O' music frae ilk leafy spray;
 While smiling Fancy led the way
 Alang the dew-bespraingled lea,
 Whare bees bumm'd thro' the flowers gay,
 An' hail'd the risin' day wi' me.

The caller breeze sugh'd ower the hill,
 An' thro' the rashy glens retir'd,
 Whare vi'lets nodding ower the rill
 Their little balmy sweets respir'd.
 The milkmaid's sang my bosom fir'd,
 An' ploughboys lilted on the lea,
 The loud bells rang,¹ an' a' conspir'd
 To hail the risin' day wi' me.¹

¹ "The bells meant are the six o'clock factory bells in Bonnie Dundee."

As a sample of his later verse, some lines to "The Early Skylark" may be given. These are dated 16th February 1841

With what delight, sweet herald of the spring,
 We hear thy earliest anthem pealed on high !
 Till heaven's loud echoes with its gladness ring,
 And love and joy fill all the brightening sky.

Thy glad effusions, airy minstrel, swell
 The glowing tide of hope within our breast ;
 As they, in accents sweet, prophetic tell
 Of vernal pleasures that we soon shall taste.

The gentle breeze, with fragrance on its wing,
 That wafts the woodland melody afar ;
 The fresh green fields and meadows glistening
 With dewy pearl, and daisy's silver star.

The forest buds all bursting into life,
 With verdure bright to cheer the raptured eye,
 And sunny paths where opening flowers are rife,
 And merry bee is heard go humming by.

The streamlet wandering through the greenwood glade,
 With sunlight sparkling on its joyous breast,
 Where gay-plumed halcyon hath its dwelling made,
 And by the murmuring waters takes its rest.

The orchard fair, with blossoms clustered o'er,
 Where young birds sport the rosy bloom among,—
 And thousand charms that Nature has in store,
 Are promised, welcome warbler, in thy song.

Still higher mount, still livelier be thy lay !
 To heaven's high portals, sprightly bird repair,
 And bear to Him who holds eternal sway
 O'er every world, my deep and ardent prayer :

That as the vernal sun, and softening shower,
 Their genial influence o'er the landscape shed ;
 Till all the richness of green leaf and flower,
 On hill and dale luxuriantly are spread :

So may young Freedom stir the human race,
 To break the ice-bonds of their winter-tune,
 And leave to Slavery no dwelling-place,
 Nor home to Want, nor nursery to Crime ;

But o'er their prospects pour its cheerful smile,
 And lead them on those days of bliss to gain
 When heaven's own Justice in our ocean isle
 With Peace and Love shall hold unceasing reign.

Like many more natives of, or residents in Dundee, he first saw himself in print in the "Dundee Advertiser." His first letter, so far as I have been able to trace, appeared in the "Advertiser" of 25th September 1828. In this letter, under the pen-name of "Spectator," he felt impelled

to challenge the "newspaper science," which was then evidently quite as "cock-sure" as it frequently is now. Other letters followed under the same signature, in one of which he gives a list of "Localities for Rare Plants in the Vicinity of Dundee," and asks information as to the habitats of certain others which he was anxious to come across.

The manuscript magazines issued by Gardiner are, as I have said, to be seen in the Dundee Reference Library, and they are all carefully written out in his own clear and well-formed handwriting. They are generally prefaced with highly ornate title pages, and, when occasion requires, drawings are also given. Gardiner apologises for his sketches—"never having been taught drawing." But there is no need for apology—he never spared "infinite pains" on his work, and the results are really admirable. His first Natural History Journal was a notebook of his own observations. Commencing 1st January 1827, it has forty-five entries, the last being for 25th October of the same year. The records given are of walks on Sunday mornings and evenings. Sometimes, he writes, he was "solus"; at others, accompanied by friends, whose identity he so far hides by the use of initials; frequently he is joined by his father. Most prominence is given to botany, but there are also notes on zoology, mineralogy, and meteorology. The places visited are various—the Law Hill, Dighty, Den of Mains, Mericmoor Wood,¹ Balgay, Blackness, Den of Fowlis, Gray, Tay Grove, Magdalen Green, but chiefly Wills Braes—"my favourite retreat, the shady wilds of Wills Braes." The Braes are now practically a thing of the past. Gardiner himself lived to see them gradually disappearing. At the making of the Dundee and Perth Railway the ground was first broken on 18th September 1845, westward of Binrock, and at that time a considerable number of trees had been cut down, and quarries dug to procure the rough stones for the sea-wall. "The operations," the local paper reports, "were sadly destructive of the natural beauties of this secluded spot." On 30th October the same paper states that Wills

¹ Gardiner invariably writes Mericmoor, now the designation is American Muir.

Braes "westward from the point where the line enters them, have been completely swept of the wood by which they were adorned." In addition to the destruction of the Braes by the railway, the walk, which the town's people had enjoyed from time immemorial, was gradually absorbed by the neighbouring feuars and proprietors, and latterly the Town Council of Dundee, in its wisdom (or otherwise), deprived the city of as attractive a bit of foreshore as any in the kingdom. Miles of stone and concrete and unlimited "dumping ground" are poor substitutes for the loss.

While Gardiner was working at these manuscript magazines and making the "peregrinations" of which he gives the results, he was also doing his daily "darg" as an umbrella-maker and mender, and doing it well. He had finished his five years' apprenticeship with Mr. Barclay, and had been engaged as a journeyman with Mr. George Robertson, hosier and umbrella-maker, near Thorter Row. He remained in Mr. Robertson's employment till he fairly quitted that occupation altogether and devoted himself to plant collecting. For many years parcels and letters dealing with natural history matters were always asked to be addressed care of Mr. Robertson. As showing that even in the mending of umbrellas there was a possible field for natural history observation, in one of his journals he gives an account, with a drawing, of a curious little insect, allied to the scorpion family, which he found upon an umbrella left for repair. Mr. Robertson took an interest in his workman's tastes and pursuits, and allowed him opportunities for botanical excursions farther from home than the Sidlaws and the country in the vicinity of Dundee. These wanderings on nature studies bent were all helping forward a purpose Gardiner had in view so early as 1831, and part of which only was realised by the publication of "The Flora of Forfarshire" in 1848. In the "Botanical Repository" for August 1831, he writes that, "in conjunction with William Jackson, we propose writing, during the winter, a Natural History of Forfarshire, our native county, in which undertaking we are desirous of receiving the assistance of our friends and acquaintances." He hoped "they would institute a research among their notebooks, to supply us with matter." He did not get the

encouragement and help he looked for, and in May 1833 he intimated the project had been dropped for the present. From his own contributions to his magazines one can gather much information as to the fauna and flora of the district. He was quick to note, and careful to record, the plants in flower or fruit; the birds, with their nests and young; the insects, with their different food plants, and the stages of their transformations. Although a botanist in the first place, all aspects of open-air life interested him. His early taste for "kailies" never left him, and it was one of his special delights to carry home the insect larvae he came across, keep them in his live-boxes, feed them with leaves from the plants on which they had been deposited as eggs, and watch the wonderful sight as the perfect insects were evolved. He relates with great glee the story of a white butterfly, thus reared, which would perch upon his finger and suck sugar from his mouth. And not only does he record his "finds": he gives also the impressions made upon his mind and heart by the scenes among which he obtained them. In one of many contributions which he made to "Loudon's Magazine of Natural History" (1831-35) this emotional experience is related in language which rises into poetry. In this same magazine also appeared an account of a "tour" he made along the coast of Forfarshire in 1831. This, given more fully in his "Botanical Repository," is very interesting reading, although some remarks he heard from the innkeeper at Auchmithie with reference to George Don do not give one such a high estimate of the Forfar botanist as Dr. Claridge Druce expresses in the British Association Dundee Handbook (1912).¹

¹ The passage is as follows: "'Mine hostess of the great room' informed me that Mr. Drummond of Forfar (Don's successor at Doo Hillock) used to lodge sometimes whole weeks in her house for the purpose of botanising the adjacent rocks and braes, and would rise and walk out every morning by three or four o'clock in pursuit of plants. On my mentioning Mr. Don, 'out spoke mine host' and pronounced a warm invective against that gentleman, who, he observed, had ruined these braes, for, since he had been prowling about there, not a plant worthy of notice was to be seen. I had no reason to doubt the veracity of mine host's assertion, for I have frequently searched Mr. Don's habitats in vain. I verily believe his plan respecting rare plants was—first to dig up all the specimens he could see, and then note the locality."

Gardiner's pleasure in these rambles and his desire to increase his knowledge made him anxious to have the opportunity of a wider field. A modest proposal he made to the Botanical Society of Edinburgh in 1838, to collect for the Society 2500 specimens of plants from the Perthshire mountains, for the sum of five guineas, was accepted by the Society. If the sum he asked was a poor return for the labour he spent and the 3000 specimens he supplied, at least it brought him into contact with many fellow-workers in Scottish botany; and, on 18th November 1838, the Society showed their regard for his work by electing him an Associate. The London Botanical Society also took advantage of his services, and added his name to the list of their Associates¹; and, as I have said, ultimately he came to devote his time altogether to the collection and distribution of British plants. From this period till his death, it would be hard to estimate how many and how varied were the specimens which passed through his hands. Orders from all parts of the three kingdoms and from the Continent found their way to his hands, and he got into communication with all the famous botanists of the time. The elder Hooker (Sir W. J.), Professor Lindley, Churchill Babington, and his better known relative, C. Cardale Babington of the "British Flora"; Hewett Cottrell Watson, the earliest investigator of the geography of British plants, with whom Gardiner botanised on the Clova Mountains; Professor Walker-Arnott of Glasgow, Professor J. Hutton Balfour, Edinburgh (a good friend to Gardiner in many ways), Professor Harvey, Dublin, the elder Lyell of Kinnordy, and his more famous son, Sir Charles, and many others, who gave him every encouragement in his work and spoke highly of him to their friends and pupils. And now in the summer and early autumn months of each year he was to be found at Clova, or among the Perthshire hills, collecting his plants in mighty loads; drying and pressing them at the nearest inns, or in shepherds' huts, and forwarding them to Dundee by the country carriers, for trains were only beginning then to make themselves infinitely useful. In some lines which he sent to his friend James Donald in London, who served his apprenticeship in one

¹ In 1849 the Linnean Society enrolled him in their list of Associates.

of Dundee's many famous nurseries—Lilybank—and afterwards was Superintendent of Hampton Court Gardens, London, Gardiner gives in versified form a hint of the ground he covered in his journeyings.

INVOCATION TO A SCOTTISH FRIEND IN LONDON,
WHILE SUFFERING UNDER ILL-HEALTH.

Again the summer's gladdening smile
Beams upon our native isle ;
And the fields are gay with flowers,
And amidst the verdant bowers
Love triumphant holds his reign,
While his voice, in joyful strain,
Makes the welkin ring again.
Wandering now in woodland green,
Where the rarest flowers are seen
Hiding from the vulgar eye—
Oft, my dearest friend, do I
Wish that thou my joy could'st share,
When I meet with blossoms rare :
And, methinks, the air so bland
Of thy healthful fatherland,
Might thy drooping powers restore
To their vigorous tone of yore.

If 'tis city's baleful breath
That hath brought thee nigh to death,
Why not leave it for a time,
And, in more congenial clime,
Breathe the air that can renew
Steady pulse and rosy hue ?
Might'st thou not with me explore
Scenes thou never traced before ?
Scenes of grandeur that impart
Lofty impulse to the heart ;
And, amid the mountains hoar,
Listening to the cataract's roar,
Spend the happy July time,
 wooing Flora in her prime.
Might we not, from Ben Venue,
Gaze on Katrine's waters blue ;
Or in Trossach's rugged dell,
Seek the flowers thou lov'st so well ?
Come ! Ben Ledi's lofty brow,
Is with bloom encircled now ;
And the sweetest breezes play
Round the lovely Loch Achray.
Come ! the forests swell with sound
Of warbling love, and all around
Breadalbane's giant mountains rear
Their independent heads, and wear
Their summer robes of beauty bright ;
And Flora's votaries invite
To banquet of supreme delight.

How happy could I climb with thee
Ben Vorlich's bold acclivity ;
Or Lawers' loftier summit seek,
Where colder breezes fan the cheek ;
Or fondly botanising stray
Along the banks of clear Loch Tay ;
Or spend the balmy evening hours
In Aberfeldy's birken bowers :
Where, in fragrant green recess,
You might hear the glad Moness
Leap from rock to rock with glee,
Singing in his revelry,
Till the very echoes seem
Quite enamoured of his theme.
Come ! while Flora o'er the land
Scatters, with a graceful hand,
Beauty, that can joy impart
To the sense, and to the heart.

Ere the voice of music dies
In the woods, and sunny skies ;
Ere the rosy moments fly
To their home,—Eternity !
Haste thee northward once again,
Leave behind the southern plain ;
And on hill and mountain free
Gather health and flowers with me.

But a fuller and more detailed record exists of the ground he covered and the work he did. He was now married, and when from home, in the summer months of 1841 to 1846, he kept his wife fully informed as to his doings. The letters are written from Clova, Killin, Ben Lawers Inn, or the Castleton of Braemar. In them he tells his wife of the progress he is making, how he has collected from 5000 to 6000 plants, but will require at least 10,000 for his season's supply. How the wet and cold weather is trying him, and the heavy bill of expenses mounting up ; how terrible the delay is with posts and carriers. How he saw "Boz" and his wife the other day at Lochearnhead ; how Hewett C. Watson and Thomas Edmonston botanised with him among the Clova Mountains. He tells her how he got a lift from Mr Gershom Cumming the engraver, who was on his way to Lochlee, with the object of sketching the landscape for his forthcoming book, "Forfarshire Illustrated" ; that the "jar" has got empty, and he has returned it with the carrier. Will she get it filled, at the usual place, and return it in the box with fresh supplies of drying paper and a gingham shirt ; his present one,

through the drenchings he has had, has got all the colours of the rainbow, and (careful man) he does not want to destroy his fine linen one by wearing it in this wet and disagreeable weather. How she would have laughed had she seen him coming to Ben Lawers Inn, literally loaded with good and rare plants: with his glengarry, two vasculums slung round his waist, and two handkerchiefs on his back, looking, for all the world, like Christian with his load of sin in the illustrated "Pilgrim's Progress" (6th July 1842). Some days after this he went to church, with notebook and pencil, prepared to send his wife the "heads" of the sermon. But when the 48th Psalm was given out in Gaelic, sung in Gaelic, and the gentleman in black began to pray in Gaelic, he thought it was time to slip out of church. He tells her he is on his last shilling, and can she manage to borrow three or four pounds, as it will be so disappointing for him to turn homewards and his season's needs not nearly supplied yet—once he is back again he will soon repay the loan. So the letters run on, and again and again reference is made to the "want of funds," which is not the chronic trouble of this generation alone, but was specially present with this gleaner in the fields of Nature. And equally apparent in the letters is the warm glow of his affection for his "dearest Elizabeth." The letters are now faded and worn: the violets, forget-me-nots, and sprigs of moss, which the lonely man sent with his love, are yellow and dry, and yet these very human documents still stir one's heart after seventy years have gone. A few of the letters of his wife I have also seen. They are poor productions; ill-expressed and badly written. But one does not estimate the woman by these things—her worth is manifest in the love she inspired in her husband.

These annual excursions of Gardiner in search of plants were very congenial to him. "He was able thus," he wrote, "to gratify his own enthusiasm for botanical pursuits, and at the same time enrich the *herbaria* of his subscribers with most of the Alpine varieties of Scotland." But the work was trying and exhausting, and told upon him in after years. Nor was it free from risk and danger. In a paper in the "Phytologist" on the "Flora of the

Breadalbane Mountains,"¹ he refers to an accident he met with on the summit of Craigalleach (upwards of 3000 feet high), when he had the misfortune to sprain his right ankle severely, and "what I then suffered in the descent and for two months after, would have cured many a one of botanising for ever; but somehow or other it only tended to increase my enthusiasm, and thus prompted me in the present season (1842) to revisit that glorious mountain altar, and there offer up to heaven grateful thanks for my recovery, and for the pure pleasure I continued to enjoy from the love of Nature's work."

Another experience is recorded by Hewett C. Watson, long afterwards in 1866, with reference to that incident alluded to in Gardiner's letter to his wife when he told her how he and Watson and Edmonston had botanised together at Clova. "We became enveloped in dense fog and driving rain. We tried long to find a safe descent down the rocks of Glen Dole, the head of Glen Clova, so as to reach the stream which would have been our guide to the inn some miles below, but were always foiled by the steepness of the crags and the denseness of the fog. At length, when nine o'clock came, it was too evident that we must choose between remaining on the mountain top all night, wet, weary, and famished, or striking down *any* declivity, in order to reach the low country. We followed a stream downwards, and shortly before midnight got inside a shepherd's hut. Our kindly host rose from his bed, made a fire, warmed some water, and mixed oatmeal in it, thus giving us the most welcome meal perhaps that I ever tasted."

In the forties of last century Gardiner was leading a busy life in Dundee, and although his fellow-townsmen might not know of it, others outside the town were quite aware of the work he was doing. In a letter Sir William Jackson Hooker wrote him (2nd July 1844) thus: "I was quite pleased to hear Lady Cornwallis speak so favourably of your plants the other day, and of her desire to encourage you. . . . I saw from your letter how valuable your time was, and how well you were occupied, and as I am in no hurry about the seven Rare Mosses, I shall

¹ "Phytologist," 1843, pp. 468-476.

much prefer your sending them when you are more at leisure."

On the occasion of Queen Victoria's visit to Dundee in 1844, some officers on board the royal yacht were very desirous of meeting Gardiner, and were quite surprised that no one seemed to know him. They were very soon put in communication with him, however, when they came upon Mr. Frederick Shaw, an old Reform Street bookseller. One of the old school, "Freddy" was a man who knew the insides of the books he sold, and his shop was quite a "howff" for the reading and thinking public of Dundee.

Gardiner was always actively connected with the Dundee Watt Institution,¹ and had been elected a Life Member as some acknowledgment of the services he rendered to it. He contributed largely to its excellent museum, catalogued its library, and lectured frequently to its members. For many years the name of William Gardiner, umbrella-maker, was in the list of the Directors of the Institution. He had benefited by the institute in his earlier years, and gladly gave his aid to make it helpful to others.

A little booklet, "Botanical Rambles in Braemar in 1844," was his first publication in 1845. In 1846 appeared his "Twenty Lessons on British Mosses," a second series of which was issued in 1849. In these handy volumes dried specimens of the mosses were mounted at the head of each lesson given. In 1848 "The Flora of Forfarshire" was published, and this, his last and principal work, found a ready welcome, being, however, more appreciated in the

¹ This institution, founded in 1824 in memory of James Watt for the "instruction of young tradesmen in the useful branches of arts and sciences," was a most important factor in the educational life of Dundee. Lecturers of eminence in science and literature were secured for its lecture courses, in which also townsmen like Macvicar, Gilfillan, J. B. Lindsay, Gardiner, and others took a helpful part. Classes were formed for the study of natural history and the physical sciences, public exhibitions were arranged, a library and reading-room established, and an extensive and varied museum gradually gathered together. For many years the institution had a vigorous and useful existence. Latterly it fell on evil times, and financial difficulties hampered its activity. The buildings raised to accommodate classes, lectures, and museum on which money had been borrowed fell into the hands of the bond-holders. The organisation was carried on in a less pretentious manner, until in 1868 it ceased to exist, and the library and museum were handed over to the Dundee Free Library, the outcome of the town's adoption of the "Free Libraries Act" in 1866.

South than in his native county. It was, and still is, a good type of a local flora, and retains for us a good deal of the old lore which was associated with flowers and herbs. It preserves the common and local names of the plants—always a desirable thing—and in this respect is a striking contrast to Dr. Buchanan White's "Flora of Perthshire," which, with many excellent features to commend it, does not give a single popular or common name. The botanical journals of the period gave the "Flora" a hearty welcome, although some of the reviewers objected to the presence of so much indifferent poetry. Objection was then, and has since been made to his adding needlessly to the richness of the county flora by including many of George Don's disputed "finds," which Gardiner has to confess he has not been able to verify. However, these points only affect the scientific botanist; to the ordinary reader, and especially to the local one, the book should always be interesting for the bits of plant lore, and the picturesque sketches it gives of the botanist's happy hunting-grounds in the county. Incidentally, too, it illustrates Gardiner's familiarity with and obligation to many local botanists who, in the third and fourth decades of last century, made the botany of Forfarshire and Perthshire bulk so largely in the natural history literature of that period. The issue of the "Flora" marked the high-water point in Gardiner's life, for somehow the tide began to turn from then. His scheme for a Fauna of Forfarshire never took shape.

While apparently considerable sums of money must have passed through his hands, yet the expenses of a good deal of his work were very heavy, and evidently he was never quite free from monetary troubles. Then, as the outcome of the trying and arduous field work of which I have spoken, his health began to give way. No frame, however robust—and his was not that—could bear such a strain unscathed. The death of his wife in May 1850 was a very sad blow, and seemed to accelerate matters. By the end of 1851 he was very seriously ill. Friendly hands and neighbours did what they could for him and his motherless boy of six years. But it was apparent that better and more regular attention and nourishment must be secured, if there was to be any chance of recovery. Dr. Charles

Osborne, well known in Dundee as a skilful doctor and a keen botanist, was unfailing in his attendance on poor Gardiner, and ultimately, on his suggestion and that of Professor J. Hutton Balfour of Edinburgh, Gardiner's friend and admirer, Mr. James Scrymgeour, was induced to write to all those who had been in communication with Gardiner, intimating to them the almost destitute condition in which he lay. "If ever this humble but enthusiastic naturalist was to recover, it would be a work of considerable time, and assistance was therefore necessary." The natural history journals gave full publicity to Mr. Scrymgeour's plea. In the "London Journal of Botany" Sir W. J. Hooker, with his usual kindness, made a special appeal for his humble brother botanist. "Few of our readers," he wrote, "but are acquainted with the botanical writings and the beautifully prepared specimens of Scottish plants by Mr. Wm. Gardiner of Dundee. Like his predecessors in the same career, Don and Drummond, his mind has been more set on studying the works of nature than in laying by a provision against a time of sickness and old age; and now it has pleased Providence to prostrate him with severe illness, at a time when, as we have reason to know, he is wholly dependent for support on what a few personal friends and others have done for him. Should this notice induce anyone to contribute to the wants of this most deserving person, donations will be thankfully received on his behalf by James Scrymgeour, Esq., 11 Reform Street, Dundee."

The response to the appeal was most gratifying—considerable sums of money being freely sent.

In the list of subscribers, afterwards printed, the name of nearly every well-known British botanist was to be found, and in many cases the kindly letters which accompanied the subscriptions showed a high regard for the humble botanist who had fallen in his life struggle.

There seemed every hope that what money and care had secured for Gardiner, would in time restore him to health and work again. He was able to move about the house, and busied himself preparing a new edition (the fourth) of his "Mosses"; but, alas, he caught the germs of typhus fever—outbreaks of which were too common in the

Overgate, and tell us something of its sanitary conditions. With his weakened frame the attack was soon fatal, and on 21st June 1852 the end came.

At the age of forty-four the Overgate naturalist "past to where beyond these voices there is peace."

A NEW AND PECULIAR ASTRAGALUS FROM THE TIBETAN FRONTIER. By W. W. SMITH, M.A.

Astragalus orotrephe, W. W. Sm. Sp. nov.

Inter species himalaicas adhuc cognitae foliis 3-foliolatis species distinctissima.

Planta nana, dense caespitosa, fere musciformis, habitu *Arenariae polytrichoides*, Edgew. vel *Androsace Selaginis*, Hook. f. et Thoms. Rhizoma lignosum ad 15 cm. longum, funiforme, multiceps, ramos numerosos columniformes arcte compactos superne gignens. Caules brevissimi numerosi, omnes cum ramis rhizomatis in glebam circ. 10 cm. diametentem, infra reliquiis foliorum delapsorum dense indutam conferti, supra foliis minimis omnino celati. Folia omnia radicalia trifoliata: rachis 4–5 mm. longa, albo-hirsutula, stipulis circ. 4 mm. longis irregulariter ovatis membranaceis albo-ciliatis instructa; foliola sessilia, medianum 3 mm. longum, lateralia 2 mm. longa, lanceolata, ita incurva ut linearia videantur, dense albo-hirsutula. Flores solitarii hinc inde in summâ glebâ paululo eminentes. Calyx 4 mm. longus, ad tertiam partem in dentes subaequales lineari-lanceolatos divisus, undique plus minusve dense hirsutulus. Corolla circ. 6 mm. longa, segmentis subaequalibus. Stamina diadelphæ. Ovarium sessile minute sparse hirsutulum stylo 3 mm. longo incurvo præditum. Fructus (immaturus) 4-semiferus.

East Himalaya.—Collected by the Political Officer, Sikkim, July 1902. Type in the Calcutta Herbarium.

The exact locality is not noted on the ticket. The specimen was probably collected on the Tibetan plateau beyond or at the boundaries of Sikkim. The plant appears to have been collected only once. From its leaves and the fewness of its seeds it does not fit well into *Astragalus*, but

is nearer that genus than any other, in my opinion. It strongly resembles in habit the tufted *Arenarias* so prevalent in the north-west corner of Sikkim, where the climate is markedly Tibetan in character, and recalls also *Androsace Selago* of the same region. It has not been recorded from Sikkim, traversed yearly by the native collectors of the Lloyd Botanic Garden, and I suspect its habitat is in the region lying to the north of the Sikkim frontier at an altitude of at least 14,000 feet.

ON THE LEAVES OF SOME SPECIES OF *BANKSIA*.

By R. C. DAVIE, M.A., B.Sc.

Von Mohl in 1846 ("Vermischte Schriften," p. 248)¹ noted in the leaves of some species of *Banksia* the restriction of the stomata to cavities lined with and partly occluded by hairs.

An examination of the leaves of the species of *Banksia* growing in the Royal Botanic Garden, Edinburgh, has revealed several types of leaf and various arrangements of the stomata. In every case the stomata are raised. Except in *Banksia serrata*, Linn., a small outer chamber ("Vorhof") is present; in *B. serrata*, Linn., the outer chamber is very prominent. The stomata occur on both surfaces of the leaf in this species; in the other species they are confined to the lower surface of the leaf.

In *B. serrata*, Linn., *B. littoralis*, R. Br., and *B. spinulosa*, Sm., there are no cavities containing the stomata. In *B. collina*, R. Br., *B. coccinea*, R. Br., and *B. grandis*, Willd., the stomata occur in shallow depressions between the projecting nerves of the leaf. In *B. attenuata*, R. Br., *B. integrifolia*, Linn., and *B. marginata*, R. Br., these depressions are deeper, but still occur only between the nerves. In *B. Menziesii*, R. Br., *B. puludosa*, R. Br., and *B. quercifolia*, R. Br., there are deep depressions in which occur subsidiary cavities. In *B. ericuefolia*, Linn., there are two deep furrows formed by the revolute leaf-margins.

An examination of material grown under natural conditions will be made when plants are obtained from Australia.

¹ Cf. R. Brown, "Suppl. pr. Prod. Flor. Nov. Holl.," p. 34.

STRATIOTES ALOIDES, LINN., NEAR CRIEFF. By
R. C. DAVIE, M.A., B.Sc. (Plate V.)

Stratiotes Aloides, Linn., though apparently indigenous in the eastern counties of England (1), where its fossil seeds have been found (2), seems to have been introduced into all its Scottish localities.

In July 1906 I found *Stratiotes* in a small loch to the west of Crieff, Perthshire, in rocks of Lower Old Red Sandstone age—conglomerates and coarse grits. Through the kindness of Mr. Wm. Barclay of Perth and of Mr. A. M. Rodger of the Perthshire Natural History Museum, I have been enabled to trace the history of this set of plants. In the Perth Museum and in Dr. Kidston's herbarium, now at Glasgow University, there are specimens of *Stratiotes* collected at this pond by Dr. Kidston in September 1884. Dr. Kidston tells me he was taken to it by the late Dr. Buchanan White, who gave the name Blackbank Pond for it.¹ On the Perth specimen there is a note that the gardener said *Stratiotes* was planted in the pond about 1861, and that it came from Ravelston, Edinburgh (by which was no doubt meant the old quarry near Blackhall, Corstorphine, or the old marl pit near Davidson's Mains).

At subsequent visits to Blackbank Pond in 1908, 1910, and in May of this year (1913), I found *Stratiotes* as abundant as in 1906.

It covers the surface of the water, except just in the centre of the pond, where *Potamogeton natans*, Linn., takes its place (Plate V., A). In the open reed-swamp surrounding the open water, *Stratiotes* is accompanied by *Typha latifolia*, Linn., and *Lemna minor*, Linn., while in the closed reed-swamp are *Comarum palustre*, Linn., *Cicuta virosa*, Linn., *Menyanthes trifoliata*, Linn., *Iris Pseudacorus*, Linn., *Typha latifolia*, Linn., *Sparganium erectum*, Linn., *Carex inflata*, Huds., and *C. vesicaria*, Linn. (Plate V., B).

¹ Mr. J. Carson Gentles writes on 14th June 1913: "I was told a few days ago by one of the old workmen that he remembers the proprietor sending bulrushes from Loch Monzievaird to be planted there. The place was perhaps in these days just a slough, and it was fenced later to save sheep and cattle from being bogged. Our old maps about 1828 do not show it, the first map on which it is depicted being 1853."



A



B

Photographs of Blackbank Pond with *Stratiotes Aloides*.

R. C. DAVIE. Photo.

At places round the outer margin of the reed-swamp occur a few plants of *Ranunculus Flammula*, Linn., *Caltha palustris*, Linn., *Cardamine pratensis*, Linn., *C. hirsuta*, Linn., *Viola palustris*, Linn., *Myosotis Scorpioides*, Linn., *Juncus effusus*, Linn., *Carex Goodenowii*, Gay, and *Glyceria fluitans*, Br. The trees beside the pond are *Betula alba*, Linn., *Alnus rotundifolia*, Mill., *Salix purpurea*, Linn., *S. phylicifolia* (Linn.), Sm., and some Conifers. Around the roots of these trees and on the ground near them are *Polytrichum commune*, Linn., *Catharina undulata*, W. et M., and *Hylocomium squarrosum*, B. et S., while on the side of the pond from which trees are absent is a considerable quantity of *Sphagnum acutifolium*, Ehrhart. A marked feature of the associations is the absence of *Phragmites communis*, Trin. *Phragmites* is not always, however, a companion of *Stratiotes* in native associations. Fleroff (3) describes the vegetation of some shallow lakes and marshes in the Wladimir district of Central Russia, where *Stratiotes* is abundant. Near the village of Polubarskoje, *Stratiotes* is associated in the open water with *Lemna minor*. On the edge of this open water there are, here and there, plants of *Cicuta virosa*, *Carex gracilis*, Curt., and *C. stricta*, Good. *Phragmites* settles down after a firm foundation has been made by these plants. As plants of *Phragmites* die, an Alder marsh gradually rises on their remains. At other places on the lake, instead of *Phragmites* there appear thick masses of *Typha latifolia*. And with *Typha* are associated *Cicuta virosa*, Carices and Alders and Birch shrubs.

From this it appears that *Phragmites communis* and *Typha latifolia* are interchangeable companions of *Stratiotes*. *Cicuta*, however, is constantly associated with it on these Russian lakes.

On the Norfolk Broads, according to Miss Pallis (4), *Stratiotes* is regularly associated with *Ranunculus circinatus*, Sibth., and *Myriophyllum spicatum*, Linn., or *M. verticillatum*, Linn. *Typha angustifolia*, Linn., and *Phragmites communis* are dominant in the reed-swamp, both open and closed, while *Cicuta virosa* is present in the closed reed-swamp, on the free water side, on the Broads of the River Ant.

In the district round Edinburgh *Stratiotes* has been present at Duddingston Loch, Lochend, and the marl pit near Davidson's Mains, from all of which it has now quite disappeared. In 1909 Mr. W. Edgar Evans (5) found it in a pool between Haddington and Morham. The records for Duddingston Loch go back to 1840. Mr. Wm. Evans, to whom I am indebted for much information about the *Stratiotes* localities near Edinburgh, does not know at what time it disappeared from Duddingston.

In the marl pit near Davidson's Mains *Stratiotes* was present until a few years ago, but there is now no trace of it, partly, no doubt, owing to the spread of *Equisetum limosum*, Linn., over the pond, more probably because of the depredations of collectors.

At Morham the only associated plant is *Lemna minor*.

Outside of the Edinburgh district *Stratiotes* has been found at Loch Rescobie, the Loch of Forfar, the Loch of Clunie, and in ponds in vice-counties 83, 84, 90, and in Perthshire. In all of these places Professor Trail (6) records it as "introduced."

The presence of marl in the pit at Davidson's Mains and at Loch Rescobie suggests one condition for the success of *Stratiotes*. The lime from the marl probably neutralises the humic acids of the ponds sufficiently to permit *Stratiotes* to thrive. The water in the Norfolk Broads must also be to some extent charged with lime from the underlying geological formation.

Mr. Gentles tells me that marl was once raised from the loch at Ochertyre, which is near Blackbank Pond, and my analysis, of water kindly sent by Mr. Gentles from Blackbank Pond, has revealed 13 grains of carbonate of lime per gallon.

Stratiotes thus appears to thrive in water more or less richly charged with lime. Experimental ecology, by introducing plants into probably favourable situations, might confirm relations to environment such as this of *Stratiotes* to lime.

In all of the situations mentioned, however, the lime is present in comparatively small proportions. An experiment worth trying would be the introduction of *Stratiotes* into such a loch as that at Carlingwark, Dumfriesshire,

where marl was once dug in quantity. Of this loch Mr. West (7) remarks that many of the submersed plants had a deposit of calcium carbonate upon their leaves.

Though *Stratiotes* appears to succeed in water containing some lime, it might be unable to live in so richly charged a lime water as this of Carlingwark Loch.

Cicuta virosa, which appears to be frequently associated with *Stratiotes*, must be able to live in a lime-charged water, but it does occur in lochs where there is apparently no lime present.

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LYCHNIS PRESLIi, SEKERA, AND OTHER LOTHIAN PLANTS. By JAMES FRASER.

In May 1913 (unless where otherwise stated) the following plants were observed in the Lothians:—

Chrysanthemum macrophyllum, Waldst. et Kit., a single clump on the margin of a field on the north slope of the Braid Hills, and several on the sloping bank west of Juniper Green Railway Station, in v.c. 83. *Polygonum aequale*, Lindlm., several at Leith Docks in 1904, v.c. 83. *Symphytum peregrinum*, Ledeb., a large colony east of North Berwick in v.c. 82; several on the edge of a field on the north slope of the Braid Hills; several by the roadside west of Colinton; a number at Marchbank near Balerno; several near Slateford; a large number in several places near the village of Cramond—all in v.c. 83; several at Carlowrie; and two or three at "Society," west of South Queensferry, v.c. 84. *Symphytum orientale*, Linn., several at Carlowrie, v.c. 84. *Lychnis Preslii*, Sekera, with herma-

phrodite flowers, a single clump on a dry bank by the side of a field on the north slope of the Braid Hills, v.c. 83. This is the second instance of the occurrence of this plant in Britain, the first being the discovery of a single clump with female flowers near Tantallon Castle, v.c. 82, by Miss Trower in 1910. The casual occurrence of this form in single plants leads to the conclusion that it is merely a glabrous form, a "mutation" or "sport," of *Lychnis diurna*, Sibth.—an opinion strongly held by Professor Domin of Prague and expressed by him in a book on "Evolutionary Theories," published in 1909 at Prague. Writing in January 1913, Professor Domin, reaffirming his opinion, says further:—"Since the (publication of) the above-mentioned book I observed directly the origin of the typical '*Lychnis Preslii*' in our Botanic Gardens, where we are cultivating only the typical hairy form. Among about forty or fifty plants of this form there arose two, perfectly glabrous, smooth and pale green."

Sekera, who found this plant in great quantity in Bohemia in 1842, at first named it *Lychnis diurna*, Sibth., var. *glaberrima*, and only on the advice of friends did he, ten years later, raise it to the rank of a distinct species under the name of *Lychnis Preslii*.

A NEW LICHEN. Communicated by JAMES M'ANDREW.

Lecanora Andrewi, B. de Lesdain, n. sp.

Crusta indistincta, apothecia numerosa, conferta, usque ad 1 mm. lata, disco pallido-vel livido-fusco, plano, margine albido crasso subintegro vel subcrenulato persistente flexuosoque cincto, C+leviter aurantiaco, KC+intense aurantiaco. Epithecium luteolum granulosum, thecium et hypothecium incolorata, paraphyses facile liberae, graciles, simplices, eseptatae, apice vix aut non incrassatae, asci clavati; sporae 8-nae, hyalinae, simplices, ellipsoideae, 11-13 (15) μ long.; 6 lat. Gelat. hym. I+intense caerulecit.

Primo intuitu *Lecanorum dispersam* in memoriam revocat.

In an old quarry in the field opposite the Braid Hills curling pond, Edinburgh; coll. James M'Andrew.

SEEDLING OF THYSANOTUS. By Professor BAYLEY
BALFOUR, F.R.S. (Plate VIA.)

Goebel figures in "Organography of Plants" (Engl. Ed.), p. 409, fig. 272, a seedling of an Australian plant, probably an *Allium*, showing a peculiar outgrowth on the surface of the cotyledon at the point where its middle portion breaks after its suctorial function is ended. By this break—which is characteristic of many monocotylous seedlings which have hypogeous germination with the cotyledon acting as the first assimilating organ—the shrunken upper part attached to the haustorium within the seed below the soil is separated from the lower actively assimilating part. The emergence from the soil of such seedlings is normally marked by and brought about by the curvature of the cotyledon fixed at one end to the rooted hypocotyl, at the other to the haustorium in the seed, and the green visible cotyledonary part of the seedling appears as a half-hoop projecting from the soil, the particles of which have been pushed aside by its general growth and extension. Goebel suggests that the outgrowth which he figures upon the surface of the cotyledon acts as a boring organ.

The peculiarity referred to is, I find, a character of the seedlings of *Thysanotus*—I have seen it in *T. multiflorus*, R. Br, *T. junceus*, R. Br—an Australian genus with outliers in the Philippine Islands and Southern China, and perhaps Goebel's species belonged to this genus and not to *Allium*. I do not find, however, that the outgrowth takes any part in promoting exit of the cotyledon from the soil. It is not a boring organ, and is a late formation after the cotyledon is above ground. It does not develop upon all seedlings in a braird, and its length varies. Its real function seems to be to act as a hydathode and allow water outgo, which is otherwise denied the seedling owing to its suctorial hypogeous extremity.

EXPLANATION OF FIGURES.

Fig. 1. *Thysanotus multiflorus*, R. Br. A series of seedlings showing the outgrowth on the cotyledon at the point where the apical portion separates.

Fig. 2. *Thysanotus junceus*, R. Br. Seedlings showing stages in development.

Photographed from nature by Robert Moyes Adam.

EMBRYO OF *LAGUNCULARIA RACEMOSA*, GAERTN.

By Professor BAYLEY BALFOUR, F.R.S. (Plate VIb.)

Laguncularia racemosa, Gaertn., is a combretaceous bush of the Western Mangrove spread over the shores of West Tropical Africa and of West and East Tropical America. Its life-history and construction are less known than those of most of the other mangrove plants. I have found no published record of its germination or of the form of the seedling—a feature to which the peculiar environment of mangroves gives particular interest.

I have had occasion to look at the fruit and embryo of the species in an excellent herbarium specimen from Florida, and whilst such material does not give evidence that enables one to depict with accuracy either embryogeny or germination, it has supplied in this case data sufficient to supplement published descriptions of the construction of the embryo.

The sessile fruits of *Laguncularia* are produced in profusion on the long branches of the inflorescence-axis. They are not pendent and are easily detached from the axis—characters all of which do not suggest vivipary.

The dry, one-seeded, one-celled fruit is derived from an inferior ovary and has a spongy, leathery pericarp. Crowning the fruit is a turbinate, leathery calyx, within which lies the hardened flower-disk with the style in the centre, and this intercalary mass forms a stopper which ultimately separates by a circumscissile slit. The fruit is therefore technically a dehiscent one, but the dehiscence is certainly not active. The club-shaped or elongated pyriform seed has a thin resinous seed-coat and hangs from the roof of the fruit cavity with the micropyle upwards.

The embryo is green within the seed, as frequently happens amongst the Combretaceae. It fills up the whole seed-cavity. There is no food store in the seed outside the embryo. As it lies in the seed the embryo is a somewhat cylindric, fat, and fleshy body about 1.5 cm. long, 2.5 mm. broad, rounded at the basal end, and running out to a narrower apical end. It consists of a central axis which is unwrapped by two cotyledonary folds.

In technical language the embryo has convolute coty-

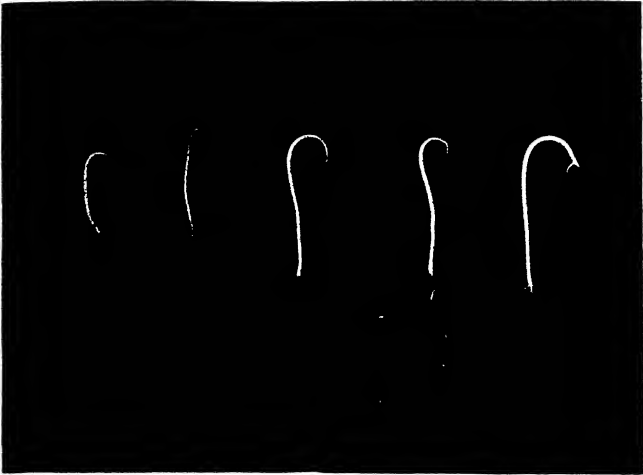
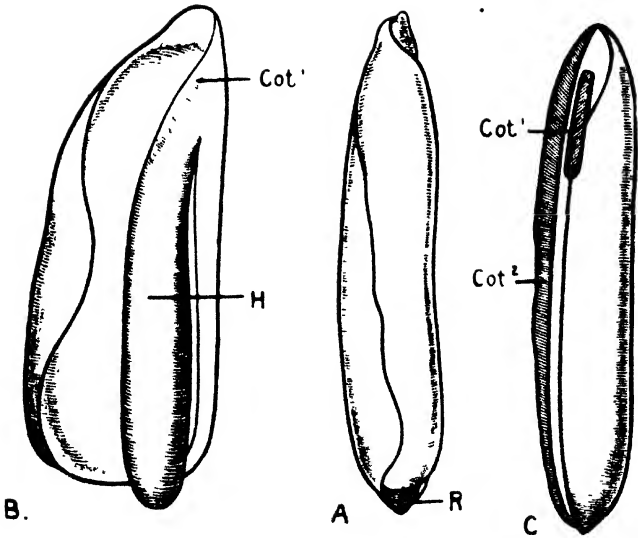


FIG. 1.

VIA.



FIG. 2.



B.

A

C

VIb.

ledons. Simple convolution of the cotyledons is not the commonest construction of the embryo—it is, in fact, rare. Its form suggests facility of extraction in an exalbuminous seed enclosed in a fruit giving restricted poral exit—but that cannot be the whole adaptation. Most commonly convolution is associated with that tortuous infolding of the parts which is technically described as contortuplicate—a condition which differs from true convolution in this, that the seed-coat follows the infoldings. Almost all genera of Combretaceae are described as having convolute cotyledons, and the true condition is found in *Terminalia* and in *Gyrocarpus*, if that be still admitted to the family. Convolution usually means auriculate cotyledonary extension which more or less covers the radicle. The degree of development depends on the length of embryo axis.

In *Laguncularia* the special feature is that the semi-macropodous axis is more than three-fourths of the length of the seed and the cotyledons appear at the summit of a stipe as short erect lobes, but each of them develops downwards from its margin an auricle on one side, the same side in the two cotyledons, the other side showing no outgrowth. The result is that the convolute part of the embryo is made up of two auricles, one from each cotyledon, enwrapping the hypocotyl.

As an adaptation to specific requirements of germination in correlation with the structure of the fruit the construction seems to suggest: when the fruit falls on the saline swamp water moistens the fruit and enters through the line of circumscission of the stopper which is loosened. As the embryo enlarges, the elongation of the hypocotyl pushes out the stopper—the construction of the fruit-wall precludes all rupture in other directions. Vivipary seems to be excluded.

EXPLANATION OF FIGURES.

- A, embryo entire with enwrapping cotyledonary auricles. R, tip of radicle.
B, embryo from which one cotyledon has been removed and the other unrolled from the hypocotyl H to show its short upward elongation above the hypocotyl and the unilateral auricle extending downwards.
C, embryo from which one cotyledon has been cut off at Cot.¹, and the auricle of the other cut off longitudinally at Cot.²

PRIMULAS OF THE BULLATE SECTION. By Professor
BAYLEY BALFOUR, F.R.S. (Plates VII.-XII.)

We are still far from having a satisfactory distribution of the species of *Primula* into natural sections within the genus, and until further exploration has brought to our knowledge the many species that undoubtedly still await discovery throughout the Himalayas and Western and Central China, we can do little more in the way of systematic grouping of the species than arrange, according to what appear to be their degrees of likeness, such forms as have become known to us, leaving to the future the discovery of the definite branches of the phyletic tree.

The section *Bullatae* which I wish to deal with here was established by Pax on the ground of a general occurrence of leaves with bullate upper surface in the species which he included in it, but the assemblage he created is only partly natural. Five species make it up, namely: *Primula Davidii*, Franchet; *P. ovalifolia*, Franchet; *P. bullata*, Franchet; *P. bracteata*, Franchet; *P. Henrici*, Bureau et Franchet—all of them Chinese.

Showing you, as I now do, specimens of these species (except *P. Henrici*, Bureau et Franchet—a plant which I have not yet seen), you will recognise that there is a marked difference in their outward appearance. There is, no doubt, a certain amount of resemblance in the bullation of the leaves in all of them; but *P. Davidii*, Franchet, and *P. ovalifolia*, Franchet, are herbaceous species very different in habit from *P. bullata*, Franchet, and *P. bracteata*, Franchet, which are woody and perennial evergreens.

P. Davidii, Franchet, and *P. ovalifolia*, Franchet, have indeed no right to be here at all, and in their fruit character they resemble the Indian species *P. obtusifolia*, Royle, and others in which the summit of the capsule breaks irregularly, leaving a large pore. This character has sectional value in the genus.

In any case, the consideration of *P. Davidii*, Franchet, and *P. ovalifolia*, Franchet, in connection with these woody

shrubby species with which Pax has united them, gives us no key to their phylogeny.

The other three species in Pax's section may form the nucleus of one section in which will fall to be included certain other Chinese and Tibetan forms of more recent discovery, namely: *Primula Forrestii*, Balf. fil.; *P. rufa*, Balf. fil.; *P. Monbeigii*, Balf. fil.; *P. pseudobracteata*, Petitm.; *P. Dubernardiana*, G. Forrest; and then I think also this is the assemblage with which we should unite the Baluchistan *P. Lucei*, Hemsley et Watt, which has hitherto, by some mischance, found itself united with plants like *P. floribunda*, Wallich, *P. Aucheri*, Jaub. et Spach, and *P. verticillata*, Forsk., with which it shows no special features of resemblance.

Pax's section of the *Bullatae* may be recast as a thoroughly natural one, including at the present time nine species. The recast is the object of this communication, in which I have written out for publication technical characters of the group along with descriptions of the included species, two of which are new and described here for the first time.

The group is a remarkable one. First of all, one must notice the suffruticose habit and the thick woody stems that are developed in the species. In *P. Lucei*, Hemsley et Watt, it is true, the lignification and secondary growth of the stem does not progress to the degree attained in other species—so much I judge from the few specimens of the species available for comparison,—but the undershrub cushion habit is there. Mr. Forrest describes *P. Dubernardiana*, G. Forrest, as “forming dense cushions of one to two feet in diameter,” and the specimen I show of *P. Forrestii*, Balf. fil., tells, better than any description, of this exceptional construction in the genus *Primula*. A photograph of *P. Forrestii*, Balf. fil., taken by Mr. Forrest in its habitat in Yunnan, has been reproduced in the “Gardeners' Chronicle” for 1910, and gives a vivid picture of the adaptation of the plant to its environment.

Perennating as they do in the form of compact cushion undershrubs, their leaves, spent so far as active assimilating work is concerned, still serve the purpose associated with

this growth-form of water-guards—that is to say, they are not immediately shed, but wither on the stems and then form a screen against the filtration of drying winds, as well as the penetration of intense sun rays, and also hold moisture as an asset, opposing to it as an agent of decay their crustaceous desiccation and resino-glandular secretion. *Passim* I may remark this desiccation of leaves in such perennating undershrubs is a field of investigation as yet unexplored—although it is one for which abundant material is ready to hand in the cushion saxifrages of the Dactyloid section. There are several types. In general terms the extremes are what we may call the crisp and the sodden. In the former the vestiges of the leaves, representing often only the petiole or the vagina, become brittle and crumple at once on handling, wound surfaces are not covered by cork, but by the hardening of tissues; in the latter the vestiges soften and collapse, and the ultimate clearance depends upon rotting of tissues which never harden. All such changes are correlated with secretion whether in the leaves or on the stem, and the story of the attunement of the several grades of these degenerations with a purpose is there for the telling by any investigator who will accept the suggestion.

This undershrub habit is only developed in two other species of *Primula*—apart from the European *Auriculas*—so far as we know them at present: in the Californian *P. suffrutescens*, A. Gray, and the Chinese *P. dryadifolia*, Franchet; but the immediate ancestry of the former is not that of this Chinese, Tibetan, and Baluchistan series, and it itself tells of an adaptation to other conditions than those which have brought about the evolution of the type of which I am speaking: and the latter is an interesting parallel development on another phyletic line within the Chinese area.

The fragrance of the plants I am referring to is one of their delightful possessions. On a warm day *P. Forrestii*, Balf. fil., scents the atmosphere, and rubbing the leaves at any time gives evidence of the perfume. Portions of dried specimens if boiled will scent a room. The hair glands are doubtless responsible for the odour in several species,

but even species without conspicuous glands give off the odour.

These undershrub primulas are evergreen—a noteworthy character, for it is not merely, as in the *Auricula*, section, the persistence of a convolute bud with a few withered leaves below it, but the permanence of the great tufts of green leaves. Yet it is not surprising to find this in alpine plants of this habit as a prelude to the desiccation in time of the leaves for the protective purpose already indicated. Petiolation of the leaves is seen in all the species, and then the blade in many of them shows conspicuously bullation of the upper surface and a consequent elevation of the veins on the under surface. This character is present in the young leaves of all the species, but it disappears in the older ones frequently, and these may have quite flat surfaces. The bullation is not by any means peculiar to this group. It is found in species of several other sections, especially in juvenile leaves, but its persistence in the adult in several of the species now under consideration gives them a physiognomy that arrests attention. Where farina is present it is aggregated prominently in the interstices of the veinlets on the under side of the leaf. Here I may add that in *P. Laceyi*, Hemsley et Watt, there is a coating of interlaced hairs which gives the plant the appearance of being covered by a snow wool.

In all the species excepting one, *P. Henrici*, Bureau et Franchet, the flowers are arranged in a simple umbel. In *P. Henrici*, Bureau et Franchet, they are described as solitary. In most of them the scape is developed, either elongated above the leaves as in *P. bullata*, Franchet: *P. rufa*, Balf. fil.: *P. Forrestii*, Balf. fil., or immersed in the leaves as in *P. bracteata*, Franchet: *P. pseudobracteata*, Petitmengin: *P. Monbeigii*, Balf. fil.: *P. Dubernardiana*, G. Forrest. *P. Laceyi*, Hemsley et Watt, is peculiar, and its construction has given origin to some misinterpretation. The flowers develop at the outset in an umbellate cluster at the end of a twig: no scape is visible: but before long the scape begins to shoot out, and subsequently when the fruit is formed the scape is evident as a distinct, though short, pillar from the top of which the fruiting pedicels

radiate. This delayed scape evolution is morphologically interesting in relation to the dispute over the development of the inflorescence in the common primrose, *P. acaulis*, Hill. In the typical primrose plant, as you are aware, there is no scape such as is found in the cowslip, *P. officinalis*, Hill, or in the oxlip, *P. elatior*, Hill. But there is a plant, found wild in several areas in Europe—in Denmark, Germany, Austria, Switzerland—and named by authors *P. acaulis*, var. *caulescens*. It has been in the past regarded as a form of the primrose in which the scape is developed. In these days when the fashion is to “solve” or “burke” riddles of form by using the word “hybrid,” this plant has become a “hybrida secundaria” (*acaulis* × *elatior*). I do not profess to give an opinion upon the issue of “delayed development versus hybrid.” All I will say is, as bearing upon this point, that here in this species *P. Laceyi*, Hemsley et Watt, we see an example of postponed scape evolution which shows that the phenomenon does appear in the genus, and so far as I know there is no experimental proof by hybridisation of the production of the form called of old *P. acaulis*, var. *caulescens*; yet its occurrence in the area over which it has been found in nature would suggest that such an artificial hybrid should be an easily produced one.

The flowers in most of this suffruticose section are yellow. In *P. Forrestii*, Balf. fil., the only one in cultivation for study, there is variation from pale sulphur-yellow to an intense golden colour, and the richness of the latter is most striking. Two species, *P. Monbeigii*, Balf. fil., and *P. Dubernardiana*, G. Forrest, from the Tibetan frontier, have rose-coloured flowers larger than those of the yellow type.

In the construction of the flower there are two forms amongst the species I include in the group. All of them have a calyx which is somewhat sclerosed at the base—the part will ultimately subtend the fruit—but the calyx never becomes concrescent with the fruit. Whilst most of them have a tubular campanulate calyx cut to a varying depth, in *P. Laceyi*, Hemsley et Watt, the campanulate calyx hardly forms a tube. With the latter character is associated an extended development of the corolla-tube, so

that its length is relatively to that of the calyx as three to one; along with this goes a marked narrowing of the tube, and the whole corolla in *P. Lacei*, Hemsley et Watt, is somewhat salver-shaped. In the other species the corolla only slightly exceeds the calyx, and its tube has a curiously transverse ridging on the inside below the anthers—a character that is not shown by the corolla-tube of *P. Lacei*, Hemsley et Watt. This marked divergence in the flower envelope characters might, in association with other features, be regarded as pointing to a natural severance of the Baluchistan plant from those with which I associate it here, were it not that in *P. pseudobracteata*, Petitmengin—a plant I am sorry to say I have not yet seen—there appears, from the description and from the comments of Petitmengin, who specially notices it, to be a connecting link. It has flower envelopes which are somewhere midway between those marking the Chino-Tibetan forms and those of the Baluchistan plant. The further finds which I anticipate of members of the series in the intervening area will have additional interest on this account.

The fruit characters in the species in which we know them are uniform. The globose or slightly ovoid capsule is inclosed in the tube of the calyx, barely projecting beyond, and it dehisces by five crustaceous valves right from apex to base. The valves vary in acuteness and width.

The assemblage of characters here enumerated gives a distinctiveness to this group of an unmistakable kind. Many of the vegetative characters may be correlated with calcicoly, and this is the habitat assigned to all the species by collectors who have given indications. Alas, how few do so! I have already referred to the excellent characterisations given by Mr. Forrest in his tickets attached to his herbarium specimens. In respect of this information Mr. Forrest as a collector is unrivalled, as he is also in the marvellously perfect condition and the fullness of his specimens.

As regards distribution, the species of the group are mainly found upon the alps of Yunnan and the borders of Tibet. *P. Lacei*, Hemsley et Watt, is an outlier. It is a far cry from Yunnan to Baluchistan; and were the inter-

vening region thoroughly explored, one might speculate on causes which had brought about the existence of similar types in a genus at so great a distance. But that same region is to be the hunting-ground of the coming generation from whose exploration many geographical and phyletic problems of plant life will receive a solution, and I am confident that on limestone areas of high altitude in that area, forms of *Primula* will be found binding together the species of this group now found in regions so far apart.

In the matter of nomenclature—am I to retain the name *Bullatae* of Pax's section for this remodelled group into which I place three of the species of Pax's section, adding six others? As I said at the outset of this communication, we are only groping at present for phyletic groupings in the genus. I hope to present for the consideration of the Society at future meetings some remarks upon the character and relationship of other species of the genus, and in course of these I shall, in the light of recent discoveries, bring forward evidence—as in some cases has been already done by others—requiring much modification of the groupings presented by Pax, which were a great advance upon all that preceded his work. In the circumstances, I think it is better therefore to indicate the group I have been dealing with by a distinct designation, and that I propose is *Suffruticosae*—recalling the predominant and vegetative feature of the species.

Of the species that are before the Society I need only say further:—

The best known one is *P. Forrestii*, Balf. fil., found by Mr. Forrest in Yunnan. It is the only member of the group in cultivation. Unfortunately it is not quite hardy in our climate. It resents the damp of the winter, as do so many of these high alpine primulas. *P. Forrestii*, Balf. fil., may be taken as a type of the yellow-flowered forms with long scape carrying the umbel far above the leaves. *P. bullata*, Franchet, and *P. rufa*, Balf. fil., are two species from Yunnan nearly allied to *P. Forrestii*, Balf. fil. Like it, they have yellow flowers: *P. bullata*, Franchet, marked by its golden farina without hairs, whilst in *P. rufa*, Balf. fil., the farina is associated with hairs. In *P. bracteata*,

Franchet, we have one of the short-scaped forms from which *farina* is absent. It is a yellow-flowered plant also. *P. Lacei*, Hemsley et Watt, is also yellow-flowered—an outlier in the way of its distribution and unique in the possession of the white or golden hairs which give it a woolly character—and showing the retarded scape development already mentioned. *P. Monbeigii*, Balf. fil., and *P. Dubernardiana*, G. Forrest, are two plants with larger flowers than those in other members of the group, and their flowers are rose-pink; the species are readily distinguished by foliage character. *P. pseudobracteata*, Petitmengin, and *P. Henrici*, Bureau et Franchet, I am unable to show. I know them only by description: the former intermediate between *P. bracteata*, Franchet, and *P. Lacei*, Hemsley et Watt; the latter distinct in the group by its solitary flower.

PRIMULA.

Section Suffruticosae, Balf. fil.

Suffruticosa saepe pulvinatim ramosa varie farinosa et glanduloso-pubescentia plerumque fragrans. Caules lignosi foliorum et scaporum vestigiis siccis vestiti. Folia juvenilia revoluta, petiolata, petiolo basi subvaginato laminaque firma saepe plus minusve bullata. Flores rarius solitarii plerumque in umbellas singulas dispositi. Calyx tubuloso-campanulatus, basi sclerosus. Corollae limbus concavus, tubus intus transversim rugosus. Capsula valvatim ab apice ad basin dehiscens calyce inclusa sed non tubo concretescens. Plantae calcicolae alpium yunnanensium et tibetorum.

A. Flores in umbella simplici.

a. Scapus foliis longior. Flos luteus.

- I. Epilosa. Aureo-farinosa. 1. *P. bullata*,
Franchet.

II. Glanduloso-pubescentia.

1. Folia basi subcuneata. 2. *P. rufa*, Balf. fil.
Corolla extus farinosa.
2. Folia basi subcordata. 3. *P. Forrestii*,
Corolla extus puberula. Balf. fil.

b. Scapus foliis brevior.

I. Flos luteus.

- | | |
|---|--|
| 1. Corollae tubus caly-
cem vix aequans.
Efarinosa. | 4. <i>P. bracteata</i> ,
Franch. |
| 2. Corollae tubus caly-
cem duplo superans. | |
| a. Albo-farinosa. | 5. <i>P. pseudobrac-
teata</i> , Petitm. |
| b. Albo- vel aureo-
lanata. | 6. <i>P. Lacei</i> , Hemsley
et Watt. |

II. Flos roseus.

- | | |
|--|--|
| 1. Folia aureo-farinosa
dentato-crenata.
Calyx ad medium
vix fissus. | 7. <i>P. Monbeigii</i> ,
Balf. fil. |
| 2. Folia sparse albo-
farinosa subintegra.
Calyx ultra medium
fissus. | 8. <i>P. Dubernar-
diana</i> , G. Forrest. |

B. Flores solitarii.

- | |
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| 9. <i>P. Henrici</i> ,
Bureau et Franchet. |
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1. *Primula bullata*, Franchet, in "Bull. Soc. Bot. France,"
xxxii. (1885), p. 265. (Plate VIIA.)

Suffruticosa, glabra. Rhizoma crassum lignosum apice
divisum et vestigiis foliorum anni praeteriti dense
obtectum.

Folia petiolata, 4-7 cm longa; lamina firma lanceolata,
2.5-3.5 cm longa 1-1.8 lata omnino glabra supra bullata
subtus intricato-elevato-reticulata ibique luteo-farinosa,
margine crenata, apice obtusa, basi in petiolum subaeque-
longum rufum anguste alatum et subvaginatum attenuata.

Scapus validus glaber erectus rufus ad apicem luteo-
farinosus 17 cm. altus umbellam unam multifloram gerens;
bracteae lanceolatae acutae subfoliaceae 1.3 cm. longae basi
margineque rufae cum pedicellis inaequalibus calyce et
corolla luteo-farinosae; pedicelli 1-1.5 cm. longi.

Calyx tubuloso-campanulatus ad 8 mm. longus, lobis
brevibus 3 mm. longis ovato-deltoides mucronulatis.

Corollae aureae tubus ad 1·3 cm. longus calyce subduplo longior intus infra antheras transverse rugosus, limbus 1-1·3 cm. diametiens lobis rotundatis emarginatis. Capsula ovata calyce inclusa.

Yunnan. On limestone rocks of Hee Chan Men. Delavay (1884), No. 114.

This species is readily diagnosed by its glabrous character and the golden farina upon the whole inflorescence. It contrasts strongly in these respects with all the other species in the section.

2. *Primula rufa*, Balf. fil. Sp. nov. (Plate VIII.)

Suffruticosa omnino pilis rufis plus minusve vestita, fragrans. Rhizoma lignosum apice divisum et vestigiis foliorum anni praeteriti dense obtectum.

Folia petiolata ad 8 cm. longa; lamina elliptica ad 6 cm. longa 3 cm. lata supra subbullata plus minusve rufo-pubescent pilis pro parte glandulosis, subtus aureo-farinosae et rufo-pubescent vix elevato-reticulata, apice obtusa, margine late crenata, basi cuneata vel in petiolum attenuata; petiolus 2-2·5 cm. longus rufus dense pilosus anguste alatus et basi vaginatus.

Scapus validus erectus 15-20 cm. altus efarinosus pilis rufis dense obtectus umbellam unam multifloram gerens; bracteae 1-1·5 cm. longae subfoliaceae efarinosae cum pedicellis et calyce rufo-pubescentes; pedicelli ad 1·5 cm. longi sed saepius bracteas subaequantes.

Calyx tubuloso-campanulatus rufus basi subincrassatus inter pilos sparse farinosus 8-9 mm. longus vix ad medium fissus, lobis oblongis obtusis.

Corollae aureae plus minusve luteo-farinosae tubus ad 1·3 cm. longus, calycem vix duplo superans, intus infra antheras transverse rugosus; limbus 1·5 cm. diametiens, lobis rotundatis bifidis.

Yunnan. Hee Chan Men. Delavay (1885), No. 305

The specimens from which the above description has been made were included in a gift of dried plants which the Director of the Herbarium at the Jardin des Plantes kindly made to the Royal Botanic Garden, Edinburgh. It bears the label *P. bullata*, Franch., and the identification

of it as that species by M. Petitmengin. Franchet¹ tells us that the plant he described as *P. bullata*, Franchet, is No. 114 of Delavay's collection. Amongst the plants sent to Edinburgh from Paris there is a specimen with this number, and I take it to be the true *P. bullata* of Franchet, matching as it does the description save in the clothing of the scape. Franchet says the scape is scabrid. I can only find a faint puberulousness at its base on the single specimen in our herbarium. This true *P. bullata*, Franchet, is an entirely different plant from that which I have described as *P. rufa*, Balf. fil., and indeed the surface distinctions are plain. I tabulate the prominent ones:—

<i>P. bullata</i> , Franch.	<i>P. rufa</i> , Balf. fil.
Plant glabrous all over.	Plant glanduloso-pilose.
Scape very glabrous, farinose at top.	Scape hairy, not farinose.
Bracts farinose without hairs.	Bracts efarinose, hairy.
Pedicels farinose without hairs.	Pedicels efarinose and hairy.
Calyx farinose without hairs.	Calyx hairy and farinose.

P. rufa, Balf. fil., has a much nearer ally in *P. Forrestii*, Balf. fil., from which it may not be found possible to separate it by distinctive marks, but without additional material showing connecting stages I prefer to keep it as a separate species.

3. *P. Forrestii*, Balf. fil., ex G. Forrest, in "Notes R. B. G. Edin.," iv. (1908), p. 228. (Plate IX.)

Suffruticosa plus minusve glanduloso-pilosa fragrans. Rhizoma crassum lignosum vestigiis siccis nigrescentibus foliorum annorum multorum obtectum.

Folia petiolata biformia, magna ad 20 cm longa cum petiolo laminam multo superante, parva ad 5 cm. longa cum petiolo lamina vix longiore; lamina ovato-elliptica v. fere rotundato-elliptica, in foliis magnis 9–10 cm. longa 5–6 cm. lata supra plana sparsissime puberula subtus non elevato-reticulata efarinosa et venis pilosis, in foliis parvis supra bullata vel subbullata glanduloso-pilosa subtus aureo-

¹ In "Bull. Soc. Bot. France," xxxii. (1885), p. 266.

farinosa elevato-reticulata et dense pubescens, foliorum omnium apice obtusa, margine crenata vel bicrenata vel crenato-dentata, basi subcordata; petiolus plus minusve hirsutus foliorum magnorum ad 12 cm. longus, parvorum 4-6 cm. longus exalatus, versus basin lateraliter paullo-expansus et subvaginatus.

Scapus validus erectus efarinosus plus minusve glanduloso-pilosus 8-23 cm. longus folia superans v. aequans umbellam unam multifloram gerens; bracteae foliaceae late lanceolatae acutae 1.3-2 cm. longae integrae ad 10 mm. latae cum pedicellis et calyce efarinosae dense glanduloso-pilosae v. pubescentes; pedicelli ad 3.5 cm. longi bracteas longe superantes.

Calyx tubuloso-campanulatus 1.2-1.4 cm. longus viridis basi subincrassatus efarinosus, lobis brevibus 4-5 mm. longis deltoideo-acutis vel oblongo-acutis

Corollae aureae efarinosae extus puberulae tubus 1.2-1.6 cm. longus sursum ampliatus ibique intense aurantiaco-coloratus infra antheras plus minusve transversim rugosus; limbus 2 cm. diametiens, lobis late ovatis vel rotundatis profunde emarginatis.

Capsula ovoideo-globosa calyce inclusa ab apice ad basin valvis crustaceis dehiscens.

Yunnan. Plant of 6 inches to 3 feet. Rootstock woody. Flowers deep yellow with an orange eye; flowers and foliage fragrant. Pendulous from dry, shady crevices of limestone cliffs on the eastern flank of the Lichiang Range. Lat. 27° 12' N. Alt. 9000-11,000 feet. May 1906. N.W. Yunnan, China. G. Forrest, No. 2117. Eastern flank of the Lichiang Range. Lat. 27° 15' N. Alt. 8000-10,500 feet. May 1910. G. Forrest, No. 5563.

The nearest ally of the plant is *P. rufa*, Balf. fil., and perhaps when a larger number of specimens of that species are available for examination the identity may be established. The most salient point of divergence between them is to be found in the golden farinose calyx and corolla of *P. rufa*, Balf. fil. There is no sign of the farina in *P. Forrestii*, Balf. fil. Again, the calyx of *P. rufa*, Balf. fil., is altogether smaller than that of *P. Forrestii*, Balf. fil., and the lobes are blunt and rounded in *P. rufa*, Balf. fil., not acute as in *P. Forrestii*, Balf. fil. The leaf of *P. Forrestii*, Balf. fil.,

has almost always the cordate base, while in *P. rufa*, Balf. fil., it is attenuately cuneate.

4. *Primula bracteata*, Franchet, in "Bull. Soc. Bot. France," xxxii. (1885), p. 264. (Plate X.)

Suffruticosa caespitosa efarinosa plus minusve pubescens. Rhizoma lignosum crassum apice ramosum vestigiis siccis foliorum et inflorescentiarum dense vestitum.

Folia petiolata 4-8 cm. longa; lamina oblonga petiolum aequans v. eo brevior supra rugosa vel subplana subtus non elevato-reticulata, apice obtusa, margine subtiliter repando-crenata basi attenuata; petiolus anguste alatus basi vaginato-expansus.

Scapus tenuis glanduloso-pubescens 3 cm. longus foliis multo brevior umbellam unam 5-10-floram gerens; bractee foliaceae ad 1.2 cm. longae lineares vel lanceolatae; pedicelli inaequales ad 2 cm. longi dense puberuli bracteis longiores v. breviores.

Calyx tubuloso-campanulatus 1-1.3 cm. longus basi subincrassatus, lobis 3-4 mm. longis oblongo-ovatis obtusis mucronulatis.

Corollae luteae tubus calycem vix superans intus infra antheras paullo rugosus, limbus magnus 1.5 cm. diametiens lobis obcordatis.

Capsula globosa.

Yunnan. Clefts of rock in the gorges of the Pee cha ho near Mo so yn, Lankong. Delavay (1883), No. 2.

A distinct species of the series marked by its non-farinose character and by the short scapes immersed in the leaves. Apparently it is not so spreading as some other species, and the herbarium specimens I have seen to show it is a plant of the habit of our *Dryas octopetala*.

5. *P. pseudobracteata*, Petitmengin, in "Bull. Herb. Boiss.," sér. 2, viii. (1908), p. 366.

Albo-farinosa tota pube partim glanduloso-scabrida. Rhizoma lignescens crassum apice vestigiis foliorum anni praeteriti dense vestitum.

Folia 2 cm. longa 5-8 mm. lata petiolata dentata subtus albo-farinosa; petiolus 1.5-2 cm. longus anguste alatus laminam aequans vel superans.

Scapus nanus folia non aequans umbellam 4-6-floram gerens; bracteae lineares 7-8 mm. longae; pedicelli bracteis longiores.

Calyx 5 mm. longus pubescens tubuloso-campanulatus lobis ad medium fissis leviter dentatis.

Corollae luteae tubus calycem duplo superans, limbus concavus 10-12 mm. diametiens, lobi obcordati emarginati.

Capsula ovato-rotunda calycem subaequans.

Yunnan. Batang. Soulié (1903). No. 4061.

Near *P. bracteata*, Franchet, from which it is distinguished by its narrow leaves, white mealy below, at least when young, by its calyx, not longer than 5 mm., and with lobes not deeply cut (whilst that of *P. bracteata*, Franchet, is 1 cm. long with deep, much narrower lobes), and by its much more elongated corolla-tube—up to 1.5 cm.,—recalling that of *P. Lucei*, Hemsley et Watt.

I only know this species from Petitmengin's description, which I have transcribed.

6. *Primula Lucei*, Hemsley et Watt, in "Journ. Linn. Soc.," xxviii. (1891), 325, pl. 41. (Plate XI.)

Suffruticosa pulvinaris fragrans caudiculis sublignosis brunneis foliis et inflorescentiis vetustis densissime vestitis hic et illic elongatis et cataphyllis paucis suffultis, plus minusve albo- v. aureo-lanatis.

Folia petiolata, 2-3 cm. longa, ad apices ramorum subrosulata; lamina 1.5-2 cm. longa 8-12 mm. lata firma obovato-spathulata vel oblonga foliorum juvenilium semper rugosa albo- vel aureo-lanata saepe glabrescens, apice rotundata vel deltoidea, margine dentata, deorsum in petiolum anguste alatum et basi vaginatim expansum attenuata.

Inflorescentia inter folia immersa; scapus sub anthesi nullus post anthesin in axem validum brevem 3-3.5 mm. longum sparsim puberulum elongatus, umbellam 3-7-floram gerens bracteae lineari-lanceolatae acutae virides puberulae 9-10 mm. longae 1.5 mm. latae; pedicelli 5.5-7 mm. longi puberuli bracteis multo-breviores.

Calyx anguste campanulatus basi subsclerosus puberulus vel albo- vel aureo-lanatus 7-8 mm. longus alte fissus, lobis 5 mm. longis submembranaceis lineari-lanceolatis acutis.

Corollae luteae tubus angustus calycem duplo superans faucem versus subamplius, limbi lobis rotundato-ovatis patentibus margine crenatis.

Capsula ovoidea 4 mm. longa calyce inclusa ab apice ad basin valvis crustaceis dehiscens.

Baluchistan. Abundant at Torkhan in clefts of limestone rocks in shady situations at about 4500 feet. Lace (1887-88), No. 3648.

This charming species is a far west outlier of the section, but so much of the area intervening between the Tibetan station and Baluchistan is unknown botanically that our ignorance alone gives cause for comment. I have little doubt about its relationship with the plants of the further East already described as belonging to this section. Its remarkable white or golden-coloured woolly investiture is a distinctive feature which we may correlate with its development in the arid zone of a land remarkable for its extreme and rapid changes of temperature. It is a desert feature. The calyx and corolla diverge somewhat from their form in the typical Suffruticosae and might give cause for hesitation over the inclusion of the species here. The calyx wants the conspicuous tube, and then the corolla is nearly salver-shaped, its long thin tube wanting apparently internal rugosities. But the description of *P. pseudo-bracteata*, Petitmengin, indicates in that species a corolla of much this character and it may be a connecting link. Hemsley and Watt point out a habit resemblance between *P. Lacei*, Hemsley et Watt, and the Arabian *P. Aucheri*, Jaub. et Spach, and *P. verticillata*, Forsk. Probably for this reason Pax has included *P. Lacei*, Hemsley et Watt, in his section Floribundae along with these species. But *P. Lacei*, Hemsley et Watt, has no affinity with the members of that section. Its allies are the plants of the section Suffruticosae as limited here, and with them it should be associated.

7. *Primula Monbeigii*, Balf. fil. Sp. nov. (Plate XII.)

Suffruticosa. Rhizoma per annos plurimos persistens crassum ramosum lignosum apice vestigiis foliorum inflorescentiarumque dense obtectum.

Folia 4-6 cm. longa petiolo laminam subaequante; lamina

elliptica, 1-1.5 cm. lata, plus minusve bullata et omnino pilis glandulosis vestita subtus aureo-farinosa, margine revoluta et late crenato-dentata, apice obtusa, basi in petiolum alatum subvaginatum dense glanduloso-pilosum attenuata.

Scapus brevis glanduloso-pilosus 1.5 cm. longus inter folia immersus eis brevior umbellam 2-floram gerens; bracteae lineares acutae piloso-ciliatae virides 1 cm. longae; pedicelli filiformes 1.5 cm. longi bracteis longiores.

Calyx tubuloso-campanulatus viridis glanduloso-pilosus basi subincrassatus 9 mm. longus vix ad medium fissus, lobis submembranaceis anguste ellipticis integris obtusis.

Corollae roseae tubus 14 mm. longus calycem superans intus infra antheras transverse rugosus, limbus 1.5 cm. latus lobis alte bifidis.

Capsula globosa calycem subaequans valvis crustaceis usque ad basin dehiscens.

Yunnan: Tzekou. Père Monbeig (1907). No. 176.

One of the short-scaped species in the section, like *P. pseudobracteata*, Petitmengin, and *P. Dubernardiana*, G. Forrest. It is nearest to *P. Dubernardiana*, G. Forrest, from which its less deeply incised calyx, and the elliptic calycine segments separate it as well as the shorter golden-mealed leaves and the whole glandular pubescence. I have not seen Petitmengin's *P. pseudobracteata*, but from his description of its long tubular corolla, short calyx (only 5 mm. long), and the white meal, I gather that it is a species distinct from Père Monbeig's plant. Our plant is strongly fragrant.

8. *P. Dubernardiana*, G. Forrest, in "Notes R. B. G., Edin.," iv. (1908), p. 221, t. xxxiiia. (Plate VIIb.)

Suffruticosa pulvinatim ramosa pube pro parte glanduloso obtecta. Rhizoma lignosum vestigiis siccis crustaceis foliorum vestitum.

Folia petiolata 5.5-6 cm. longa; lamina 2.5-3 cm. longa, 8-10 mm. lata, anguste lanceolata petiolum equans, supra non bullata fere plana plus minusve glanduloso-pubescent, subtus sparsim albo-farinosa et pubescens, apice obtusa, margine subintegra vel subtiliter repanda, basi in petiolum pilosum anguste alatum subvaginatum gradatim extensa.

Scapus brevis efarinosus, 2·5 cm. altus, foliis multo brevior, pilis vestitus et umbellam 3-5-floram gerens; bracteae lineares submembranaceae efarinosae pilosiusculae 1-1·4 cm. longae; pedicelli filiformes pubescentes 1·8-2·2 cm. longi.

Calyx tubuloso-campanulatus pubescens 9-10 cm. longus, alte fissus basi subincrassatus, lobis lineari-lanceolatis 6-7 cm. longis obtusis.

Corollae pallide roseae fauce luteo tubus calycem vix superans intus infra antheras subrugosus, limbus latus 2 cm. diametens, lobis late obcordatis alte marginatis.

South East Tibet. Forrest. No. 308. Dry situations on the ledges and in the clefts of cliffs on the eastern flank of the Mekong-Salween divide, Mekong valley. Lat. 28° 6' N. Alt. 8000-9000 feet. June-July 1904.

This with *P. Monbeigii*, Balf. fil., is a pink-flowered species amongst allies having yellow flowers. Its nearest relation is *P. Monbeigii*, Balf. fil., but it wants the bullate leaves and golden farina of that species, in which also the calyx lobes are much shorter. From *P. bracteata*, Franchet, in addition to the flower colour, the shape of the leaf and the leafy involucre in that species are marks of separation. *P. Henrii*, Bureau et Franchet, with which it has only superficial resemblance, is separated easily by its solitary flower and short calyx.

From the description of Mr. Forrest we gather that this plant in its native habitat on the limestone cliffs on the banks of the Mekong, forms dense cushions one or two feet in diameter—a striking sight when covered with its rose blossoms, which are relatively large for this section. In the size of flower it seems to resemble *P. Monbeigii*, Balf. fil.

9. *P. Henrii*, Bur. et Franchet in Morot, "Journ. de Bot.," v. (1891), 98, t. 2.

Rhizoma basibus persistentibus foliorum vestitum.

Folia lanceolata, in petiolum attenuata, apice subobtusa, marginibus paululum revoluta, sinuato-denticulata, facie superiore pilis glandulosis pubescentia, inferiore albo-pulverulenta, vetustate undique rubiginosa.

Flores solitarii.

Pedunculus glanduloso-pubescens, foliis brevior.

Calyx campanulatus, pilis brevibus glandulosis pubescens, necnon albo-pulverulentus, 5-lobatus, lobis tubo paulo brevioribus, ellipticis, obtusis.

Corolla tubo cylindrico, apice dilatato, quam calyx multo longiore, lobis obovalibus, alte emarginatis.

Folia 2-3 cent. longa; pedunculus 15-20 mm. longus; calyx 5 mm.; corollae tubus 10-12 mm., lobi 5-10 mm. longi.

Thibet, entre Lhassa et Batang. 1 mai.

Espèce très remarquable par sa végétation qui la place dans le voisinage du *P. bullata* Franch., tandis que les caractères de ses fleurs la rapprochent davantage des *Aleurites*. Le rhizome se divise en plusieurs ramifications recouvertes par les bases persistantes et très serrées des anciens pétioles, et porte à son sommet des rosettes de feuilles très rapprochées. Le pédoncule commun reste très raccourci, presque nul, de sorte que les fleurs, peu nombreuses, paraissent basilaires. Le *P. dryadifolia* Franch., offre quelques particularités analogues, tout en restant bien distinct par la forme de ses feuilles et par celle du calice.

I only know this plant from Bureau and Franchet's description, which I have transcribed.

LIST OF PLATES.

- Plate VIIA. *Primula bullata*, Franch.
- " VIIIB. *Primula Dubernardiana*, G. Forrest.
- " VIII. *Primula rufa*, Balf. fil.
- " IX. *Primula Forrestii*, Balf. fil.
- " X. *Primula bracteata*, Franch.
- " XI. *Primula lacei*, Hemsley et Watt.
- " XII. *Primula Monbeigii*, Balf. fil.

All from photographs by Mr. R. M. Adam of the Royal Botanic Garden, Edinburgh.

Plate VIIIB. of *Primula Dubernardiana*, G. Forrest, appeared in the "Notes of the Royal Botanic Garden" as an illustration of Mr. Forrest's paper on Chinese Primulas. It is reproduced here by permission of the Controller of H.M. Stationery Office.



EXHIB. MUS. CALIF.
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Primula rufa, Balf. fil.



Primula Forresteri, Balf. fil.



Collected by H. Luce Esq.
Inverness & Strath
Glen
Primula Lucei; Watt MS.
Primula Lucei, Hemsley et Watt.



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PLANTS. - J. W. V. SNAX
GEO. PL. & MOUNT. 150

Promela Monbetta, Balf. fil.

TRANSACTIONS
OF THE
BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXVIII,

ADDITIONS TO THE FLORA OF ORKNEY, AS RECORDED IN
WATSON'S "TOPOGRAPHICAL BOTANY," Second Edition.
By Colonel H. H. JOHNSTON, C.B., D.Sc., F.R.S.E.,
F.L.S.

(Read 15th January 1914.)

This paper forms a continuation of the one on the same subject which I read before the Scottish Natural History Society on 4th April 1895, and which was published in "The Annals of Scottish Natural History," July 1895. Chiefly on account of my having been so much abroad, I have done no botanical work in Orkney since 1895, with the exception of the summer and autumn of 1912 and 1913, during which two years most of the plants mentioned in this paper were collected.

Before and since the publication of the second edition of Watson's "Topographical Botany," in 1883, several of the plants mentioned in the following list have been recorded from Orkney by me and others; but, as the value of botanical records is greatly enhanced by the possession of authentic specimens, I have included in this list the names of all specimens in my herbarium, which are either additional to, or confirm doubtful records of, the plants recorded from county No. 111, Orkney, in the second edition of the above-mentioned work.

In the case of those plants which have already been

recorded from Orkney, references are given in the following list, under each species and variety, to the books in which the records have been published. These records are principally contained in the Annual Reports of the Botanical Exchange Club of the British Isles; "A New List of the Flowering Plants and Ferns of Orkney," edited by W. A. Irvine Fortescue, and published in "The Scottish Naturalist," 1882-1884; and "Supplement to Topographical Botany, ed. ii.," by Arthur Bennett, published in "The Journal of Botany," 1905.

The nomenclature followed is that of the second edition of Watson's "Topographical Botany," except in the case of species and varieties which are not recorded in that work. In the latter case the nomenclature adopted is that of "The London Catalogue of British Plants," tenth edition, 1908.

Non-native plants, which have become naturalised in Orkney, are distinguished by a * prefixed to the names, and the names of casuals are printed in italics.

Of the 31 species and varieties recorded from Orkney in the following list, 27 are native, 1 is naturalised, and 3 are mere casuals introduced into Orkney through the agency of cultivation.

ABBREVIATIONS.

"Annals Scot. Nat. Hist." = The Annals of Scottish Natural History. Bennett, "Suppl. Top. Bot." = Supplement to H. C. Watson's Topographical Botany, second edition. By Arthur Bennett, 1905.

"Bot. Exch. Club Report" = Report of The Botanical Exchange Club of the British Isles, at present called The Botanical Exchange Club and Society of the British Isles.

"Journ. Bot." = The Journal of Botany.

"Scot. Nat." = The Scottish Naturalist.

Watson, "Top. Bot." = Topographical Botany. Second edition. By H. C. Watson, 1883.

CORRECTIONS.

As "The Annals of Scottish Natural History" has ceased to be published, I take this opportunity of correcting two mistakes which occurred in my paper published in that magazine in July 1895, viz. :—

On page 176 for **LUPINUS PERENNIS*, Linn., read **LUPINUS NOOTKATENSIS*, Donn.

On page 179, after *PYROLA ROTUNDIFOLIA*, Linn., delete "Rousay, A. R. Duguid; and Rousay, 30th July 1881,

James Reid. Native. The specimen collected by Dr. Duguid was given to me by Miss Mary Gold, who received it from Dr. Duguid," and *substitute* the following:—Rousay, August 1869, Miss G. Gold; and Rousay, 30th July 1881, James Reid. Native.

CLASS I.—DICOTYLEDONS.

FUMARIA PURPUREA, *Pugsley* (*fide* Arthur Bennett).—Turnip-field, Swanbister, Orphir, Mainland, 27th August 1880, Henry Halcro Johnston. The same specimens were identified as *F. PALLIDIFLORA*, *Jord.*, *var. BORÆI*, (*Jord.*), by the late Dr. J. T. I. B. Boswell.—Oat-field, 80 feet above sea-level, Brims, Waas, Hoy, 4th August 1913, H. H. Johnston. A weed of cultivation at both stations. See "Scot. Nat.," No. xlvii., July 1882, p. 322; "*FUM. BORÆI*, Segregate," in Watson, "*Top. Bot.*," ed. ii., 1883, p. 25; and "*F. BORÆI*, *Jord.*," in "*Journ. Bot.*," vol. xxxix., August 1901, p. 267.

Trifolium agrarium, Linn. (*fide* Arthur Bennett).—Hay-field, 120 feet above sea-level, Lower "Tween-the-Brecks, Gyre, Orphir, Mainland, 2nd August 1912, H. H. Johnston. Not native; introduced with clover seeds. Very rare.

Pisum elatius, M. Bieb. (*fide* W. G. Craib).—Vetch- and oat-field, 20 feet above sea-level, near Loch of Saintear, Westray, 23rd August 1913, H. H. Johnston. Not native; introduced with the seeds of the cultivated Common Vetch (*Vicia sativa*, Linn.).

ROSA CANINA, Linn., *var. SPHÆRICA* (*Gren.*) (*fide* J. G. Baker).—Heathery banks at burnside, 180 feet above sea-level, Berriedale, Hoy, 4th November 1913, H. H. Johnston. Native.

ROSA GLAUCA, Vill., *var. CRÉPINIANA*, (*Déségl.*) (*fide* J. G. Baker).—Banks at burnside, 15 feet above sea-level, Mill Burn, Stromness, Mainland, 30th August 1912. Native. Rare.

Crepis niccæensis, Balbis (*fide* Arthur Bennett).—Hay-field, 120 feet above sea-level, Lower "Tween-the-Brecks, Gyre, Orphir, Mainland, 2nd August 1912, H. H. Johnston. Not native; a weed of cultivation.

HIERACIUM ANGLICUM, *Fries*, "*Symb. ad Hist. Hier.*,"

1848, p. 93 (*vide* J. T. I. B. Boswell and F. J. Hanbury).—Crags on hillside, Wart Hill, Hoy, 12th August 1880, 18th August 1881, and 20th August 1885 in the Glen of Gair, H. H. Johnston. Native. Removes “[111 Orkney]” from the “supposed errors” in Watson, “*Top. Bot.*,” ed. ii., p. 232. See “*Scot. Nat.*,” No. xlviii., October 1882, p. 195; “*Bot. Exch. Club Report*,” 1886, p. 154; “*Journ. Bot.*,” vol. xxxix., August 1901, p. 269; and Bennett, “*Suppl. Top. Bot.*,” ed. ii., 1905, p. 49.

HIERACIUM RUBICUNDUM, *F. J. Hanbury*, in “*Journ. Bot.*,” vol. xxx., 1892, p. 208 (*vide* E. F. Linton).—Sandstone cliffs at the seashore, 10–30 feet above sea-level, west side of Walkmill Bay, Orphir, Mainland, 19th and 20th July 1912, H. H. Johnston; and heathery and grassy cliffs at the seashore, 40 feet above sea-level, Melsetter, Waas, Hoy. 11th August 1913. Native at both stations.

Note.—The late Rev. W. R. Linton gathered specimens of a *HIERACIUM*, in my company, at the Dwarfie Hamars (“Quoys Hamars”), Hoy, on 10th August 1886, which he labelled and recorded as “*H. RUBICUNDUM, F. J. Hanbury*,” in “*The Journal of Botany*,” vol. xxxi., June 1893, p. 178; but his brother, the Rev. E. F. Linton, informs me that these specimens are not *H. RUBICUNDUM, F. J. Hanbury*, which is not recorded from Orkney in “*An Account of the British Hieracia*,” by the Rev. W. R. Linton, 1905, p. 25. The Rev. E. F. Linton is doubtful to which species these specimens (rather poor ones) belong, but he thinks they may be *H. RUBICUNDUM, F. J. Hanbury, var. BOSWELLI, Linton*, which is recorded from Orkney in “*The Journal of Botany*,” vol. xxxi., June 1893, pp. 178 and 179 (as a species), and in “*An Account of the British Hieracia*,” by the Rev. W. R. Linton, 1905, p. 25.

HIERACIUM CALEDONICUM, *F. J. Hanbury*, in “*Journ. Bot.*,” vol. xxvii., 1889, p. 75 (*vide* E. F. Linton).—Grassy cliffs at seashore, 20–30 feet above sea-level, Scapa, Saint Ola, Mainland, 5th July 1912, H. H. Johnston. Native. See “*Journ. Bot.*,” vol. xxxi., June 1893, p. 178; “*An Account of the British Hieracia*,” by the Rev. W. R. Linton, 1905, p. 26; and “*Bot. Exch. Club Report*,” 1912, p. 263.

HIERACIUM BUGLOSSOIDES, Arv.-Touv., “*Les Hier. d. Alp. Franç.*,” 1888, p. 72 (*vide* E. F. Linton).—The same speci-

mens were identified as "*H. VULGATUM*, *Fries*," by the late Dr. J. T. I. B. Boswell. Cliffs at the seashore, west side of Walkmill Bay, Orphir, Mainland, 15th August 1881, H. H. Johnston. Native.

HIERACIUM SILVATICUM, *Gouan*, var. *TRICOLOR*, *W. R. Linton*, in "An Account of the British Hieracia," by the Rev. W. R. Linton, 1905, p. 39 (*vide* E. F. Linton).—Craggs on hillside, 430 feet above sea-level, Dwarfie Hamars, Hoy, 22nd July 1912, H. H. Johnston. Native.

HIERACIUM ORCADENSE, *W. R. Linton*, in "Journ. Bot.," vol. xxxi, June 1893, p. 196 (*vide* E. F. Linton).—Craggs on hillside, Hoy, 14th August 1879, H. H. Johnston (the same specimen was identified as "*H. VULGATUM*, *Fries*, var.—probably the same as *H. CÆSIUM*, *Fries*," by the late Dr. J. T. I. B. Boswell); craggs on hillside, 430 feet above sea-level, Dwarfie Hamars, Hoy, 10th August 1886, H. H. Johnston (in company with the late Rev. W. R. Linton, who named and described the species from the specimens collected by him on that date), and 22nd July 1912, H. H. Johnston: and sandstone cliffs at the seashore, 10-30 feet above sea-level, west side of Walkmill Bay, Orphir, Mainland, 19th and 20th July 1912. Native at all these stations. See "Journ. Bot.," vol. xxxi, June 1893, p. 197; "An Account of the British Hieracia," by the Rev. W. R. Linton, 1905, p. 65; and "Bot. Exch. Club Report," 1912, p. 264.

ARCTIUM VULGARE, *A. H. Evans*, subvar. *PYCNOCEPHALUM*, *A. H. Evans*, in "The Journal of Botany," vol. li. p. 117 (April 1913) (*vide* Arthur Bennett).

SYNONYMY:—

ARCTIUM INTERMEDIUM, *Babington*, in "Annals and Mag. Nat. Hist.," series 2, vol. xvii. p. 374 (1856); and Babington, "Manual of British Botany," fourth edition, p. 184 (1856).

ARCTIUM NEMOROSUM, *Babington*, in "Annals and Mag. Nat. Hist.," series 3, vol. xv. p. 10 (1865); and Babington, "Manual of British Botany," seventh edition, p. 197 (1874), *non* Lejeune.

ARCTIUM MINUS, *Schkuhr*, subsp. *NEMOROSUM*, *Syme*, "English Botany," third edition, vol. v. p. 25, t. 701 (1866), excl. syn.

ARCTIUM NEWBOULDII, *Arthur Bennett*, in "The Journal of Botany," vol. xxxvii. p. 342 (1899); and in "The Irish Naturalist," vol. xii. pp. 289 and 290 (1903).

Sandy banks at the seashore, Linksness, Hoy, 1st September 1875 and 31st August 1883, H. H. Johnston; roadside, near the Black Crag, Stromness, Mainland, 23rd August 1880, H. H. Johnston; shell-sandy pasture, Skaill, Sandwick, Mainland, 4th August 1886, H. H. Johnston; very rare on sandy links at the seashore, 20 feet above sea-level, Links of Melsetter, Waas, Hoy, 11th August 1913; and shell-sandy roadside, 15 feet above sea-level, The Links, Westray, 26th August 1913, H. H. Johnston. Native at all these stations. See under "ARCTIUM NEMOROSUM, *Lejeune*," in "Scot. Nat.," No. xlviii., October 1882, p. 367; Watson, "Top. Bot.," ed. ii., 1883, p. 240, in which the record of this species from Orkney is queried thus, "111 Orkney?"; "Bot. Exch. Club Report," 1883, p. 90; and "Annals Scot. Nat. Hist.," July 1895, p. 178; and under "ARCTIUM NEWBOULDII, *Arthur Bennett*," in Bennett, "Suppl. Top. Bot.," ed. ii., 1905, p. 51, in which the record from "111 Orkney" refers to the specimens collected by me at Linksness, Hoy, on 31st August 1883.

Note.—Mr. A. H. Evans, in his article on "The British Species of *Arctium*," in "The Journal of Botany," vol. li., April 1913, pp. 113–118, states that the "ARCTIUM NEMOROSUM" of British authors is merely a subvariety of *A. VULGARE*, *A. H. Evans*, "with comparatively sessile heads at the ends of the branchlets and apparently no other constant feature," to which he has given the name *subvar. PYCNOCEPHALUM*, *A. H. Evans*. It is not the "ARCTIUM NEMOROSUM, *Lejeune*," the description and photograph of which, Mr. Evans states, "seem to be conclusive as to its being *A. MINUS*, *Bernh.*" According to Mr. Evans, *ARCTIUM VULGARE*, *A. H. Evans*, *subvar. PYCNOCEPHALUM*, *A. H. Evans*, is that form which is usual in Scotland, extending from the Border northwards to Orkney and Shetland, while typical *A. VULGARE*, *A. H. Evans* (= *A. INTERMEDIUM*, *Lange*, and *A. PUBENS*, *Babington*, "Manual of British Botany," ninth edition, 1904, p. 217), Mr. Evans states he has not found north of Haddingtonshire and the Isle of May.

SOLIDAGO VIRGA-AUREA, *Linn.*, var. *CAMBRICA* (*Huds.*) (*vide* Arthur Bennett).—Heathery hill-top, 650 feet above sea-level, on the south-west side of Hoglinns Water, Waas, Hoy, 13th August 1913, H. H. Johnston. Native.

**INULA HELENIUM*, *Linn.* (*vide* Arthur Bennett).—Grassy bank at burnside, near the sea, 5 feet above sea-level, Burn of Stennadale, Firth, Mainland, 7th August 1913, H. H. Johnston; and ditch-side in links near the sea, 20 feet above sea-level, Links of Melsetter, Waas, Hoy, 11th August 1913, H. H. Johnston. Naturalised and very rare at both stations—one clump of a few plants only at the former station, and two clumps of a few plants only in each clump at the latter station. See "Scot. Nat.," No. xlviii., October 1882, p. 369.

The aggregate species *EUPHRASIA OFFICINALIS*, *Linn.*, is recorded from Orkney in Watson, "Topographical Botany," ed. ii., p. 292, but the following segregate species are not mentioned in that book:—

EUPHRASIA BREVIPILA, *Burnat et Gremli* (*vide* E. S. Marshall).—Grassy crags at the seashore, 15 feet above sea-level, east side of Aith Hope, South Waas, Hoy, 21st July 1913, H. H. Johnston. Native. See "Journ. Bot.," vol. xxxix., August 1901, p. 270.

EUPHRASIA BOREALIS, *Townsend* (*vide* E. S. Marshall).—Stenness, Mainland, 6th August 1875, H. H. Johnston; pasture, Binscarth, Firth, Mainland, 21st August 1880, H. H. Johnston; pasture, Skaill, Sandwick, Mainland, 19th August 1881, H. H. Johnston (see "Bot. Exch. Club Report," 1881, p. 53); dry sandy pasture, Linksness, Hoy, 20th August 1885, H. H. Johnston (see "Bot. Exch. Club Report," 1885, p. 133; heathery and grassy pasture, 90 feet above sea-level, Black Crag, Stromness, Mainland, 19th August 1912, H. H. Johnston (see "Bot. Exch. Club Report," 1912, p. 273, in which the specimens from the Black Crag have been erroneously recorded as *EUPHRASIA CURTA*, *Wettst.*, but this error will be corrected in the Report for 1913); and heath at top of crags at the seashore, 130 feet above sea-level, Brims, Waas, Hoy, 4th August 1913, H. H. Johnston. Native at all these stations. The specimens from Brims have the corolla white, with dark purple lines, and a yellow spot on the throat of the lower lip, and with reference to

them the Rev. E. S. Marshall furnished me with the following remarks:—"Difficult to name with confidence; no fruit is present. But I believe it to be a dwarf, compact state of *E. BOREALIS*, *Townsend.*" This species was growing in patches near to other patches of *E. CURTA*, *Wettst.*, var. *GLABRESCENS*, *Wettst.* (*vide* E. S. Marshall), which had the corolla pale lilac, with dark purple lines, and a yellow spot on the throat of the lower lip. See "Journ. Bot.," vol. xxxix., August 1901, p. 270.

EUPHRASIA GRACILIS, *Fries* (*vide* E. S. Marshall).—Hoy, 15th August 1874, H. H. Johnston; heath, Waas, Hoy, 9th August 1877, H. H. Johnston; grassy banks at burnside, 15 feet above sea-level, Burn of Ore, Waas, Hoy, 16th July 1912, H. H. Johnston; heath at burnside, 10 feet above sea-level, Pegal Burn, Waas, Hoy, 7th August 1912, H. H. Johnston; heathery banks at burnside, 240 feet above sea-level, North Dale, Waas, Hoy, 7th August 1912, H. H. Johnston; heath on hillside, 320 feet above sea-level, Brunt Hill, Stromness, Mainland, 23rd August 1912, H. H. Johnston; and heath 200 feet above sea-level, near Rosehill, Stromness, Mainland, 30th August 1912, H. H. Johnston. Native at all these stations. With reference to the specimens from Brunt Hill, the Rev. E. S. Marshall furnished me with the following remarks:—"Difficult to name accurately, being starved. I incline to think it a reduced state of *E. GRACILIS*, *Fries*, with rather crowded leaves; the small flowers favour this. If not, it is small *E. CURTA*, *Wettst.*, var. *GLABRESCENS*, *Wettst.*" With reference to the specimens from Burn of Ore, Pegal Burn, and Brunt Hill, see "Bot. Exch. Club Report," 1912, p. 272.

EUPHRASIA SCOTTICA, *Wettst.* (*vide* E. S. Marshall).—Heath on hillside, 310 feet above sea-level, North Dale, Waas, Hoy, 7th August 1912, H. H. Johnston. Native. Remarks on my specimen by the Rev. E. S. Marshall:—"This has the habit and general appearance of *E. SCOTTICA*, *Wettst.*, and I think that it is best so named; material rather young, and not in fruit." See "Journ. Bot.," vol. xxxix., August 1901, p. 270; and "Bot. Exch. Club Report," 1912, p. 273.

EUPHRASIA CURTA, *Wettst.* (*vide* E. S. Marshall).—Pasture at edge of crags at the seashore, Ness of Ramnago, Sand-

wick, Mainland, 23rd July 1886, H. H. Johnston. Native. See "Transactions of the Botanical Society of Edinburgh," vol. xvii., 1886, p. 133; "The Gardeners' Chronicle," vol. xxvi., No. 677, new series, 18th December 1886, p. 793; and "Journ. Bot.," vol. xxxix., August 1901, p. 270.

EUPHRASIA CURTA, *Wettst., var. GLABRESCENS, Wettst. (fide E. S. Marshall)*.—Damp pasture on hillside, 300 feet above sea-level, Wart Hill, Hoy, 15th August 1912, H. H. Johnston; grassy banks at burnside, 270 feet above sea-level, Burn of Selta, Stromness, Mainland, 23rd August 1912, H. H. Johnston; marsh 300 feet above sea-level, Dale of Oback, Orphir, Mainland, 9th July 1913, H. H. Johnston; and heathery and grassy pasture at top of crags at the seashore 130 feet above sea-level, Brims, Waas, Hoy, 4th August 1912, H. H. Johnston. Native at all these stations. See remarks under E. BOREALIS, *Townsend*, on p. 213; and "Journ. Bot.," vol. xxxix., August 1901, p. 270.

EUPHRASIA FOULAENSIS, *Townsend (fide E. S. Marshall)*.—Short pasture, 150 feet above sea-level, drenched with sea spray during storms, Vaval, Westray, 21st August 1913, H. H. Johnston. Native. Remarks by the Rev. E. S. Marshall:—"Your Westray Eyebright is the compact coast-form of EUPHRASIA FOULAENSIS, *Townsend!*, which Shoolbred and I found at Black Craig, Mainland, in 1900. The full-grown capsules considerably exceed the sepals: the leaves are blunt, glabrescent; the corollas small, violet." See "Journ. Bot.," vol. xxxix., August 1901, p. 270.

TRIENTALIS EUROPEA, *Linnaeus*.—Heath, 200 feet above sea-level, Kingsdale, Firth, Mainland, 9th July 1913, H. H. Johnston. Native. Removes the ? after "111 Orkney?" in Watson, "Top. Bot.," ed. ii., p. 335. This species was first discovered in Orkney at the above-mentioned station, in June 1847, by the late Mr. George Robson. See MS. "Flora Orcadensis," by Alexander R. Duguid, M.D., 1858: and Bennett, "Suppl. Top. Bot., ed. ii.," 1905, p. 68.

CLASS II. - MONOCOTYLEDONS.

CAREX EXTENSA, *Good., var. MINOR, Syme (fide Arthur Bennett)*.—Stony ground near the seashore, 130 feet above sea-level, North Hill, Westray, 28th August 1913, H. H. Johnston. Native. Removes "Lost" from "111 Orkney.

Lost? Syme cat." in Watson, "Top. Bot.," ed. ii., p. 461. The late Dr. J. T. I. B. Boswell found the *var. MINOR*, *Syme*, in the Fidge, Orphir, Mainland, in 1849, but in his catalogue of Orkney plants he has entered the remark "Extinct 1875?" opposite the name of this variety. Prior to 1849 the Fidge was liable to be flooded with sea water; but, about that year or shortly thereafter, an embankment and sluice were constructed to prevent the flooding. See "Scot. Nat.," No. ii., new series, October 1883, p. 73.

CAREX FULVA, *Host.*, \times *OEDERI*, *Retz.* (*fide* Arthur Bennett).—Pasture at lochside, 15 feet above sea-level, Loch of Saintear, Westray, 23rd August 1913, H. H. Johnston; and pasture at lochside, 8 feet above sea-level, Loch of Swartmill, Westray, 6th September 1913, H. H. Johnston. Native, and very rare at both stations. At the former station a small clump of this hybrid was growing in the middle of a much larger clump of *CAREX OEDERI*, *Retz.* (*fide* Arthur Bennett).

AVENA PRATENSIS, *Linn.* (*fide* Arthur Bennett).—Very common on sandy links at the seashore, 20 feet above sea-level, Links of Melsetter, Waas, Hoy, 11th August 1913, H. H. Johnston. Native. Each spikelet has one awn only, instead of two or three awns as usually occurs in this species. Remark by Mr. Arthur Bennett:—"Your plant seems to agree with Norman's *f. PAUCIFLORA*, 'Fl. Arcticae Norvegiae,' p. 54, 1893." See "Scot. Nat.," No. iii., new series, January 1884, p. 110.

GLYCERIA PLICATA, *Fries* (*fide* Arthur Bennett).—Marsh 20 feet above sea-level, Burn of Ore, Waas, Hoy, 29th July 1913, H. H. Johnston. Native. Removes the ? "doubtful" after "111 Orkney ? 'doubtful'" in Watson, "Top. Bot.," ed. ii., p. 488. See "Scot. Nat.," No. iii., new series, January 1884, p. 111; "Journ. Bot.," vol. xxxix., August 1901, p. 274; and Bennett, "Suppl. Top. Bot., ed. ii.," 1905, p. 105.

FESTUCA SCHUROIDES, *Roth* (*fide* Arthur Bennett).—Shell-sand and shingle at the seashore, 5 feet above sea-level, Bay of Skail, Sandwick, Mainland, 27th September 1913, H. H. Johnston. Native. Removes "(111 Orkney)" from the "non-indigenous plants" in Watson, "Top. Bot.," ed. ii., p. 495. See "Scot. Nat.," No. iii., new series, January

1884, p. 111 ; and Bennett, "Suppl. Top. Bot., ed. ii.," 1905, p. 107.

TRITICUM REPENS, *Linn.*, var. *LEERSIANUM*, *Gray* (*vide* Arthur Bennett).—Shell-sand and shingle at the seashore, 5 feet above sea-level, Hookin, Papa Westray, 4th September 1913, H. H. Johnston. Native. The var. *LEERSIANUM*, *Gray*, was growing side by side with typical *TRITICUM REPENS*, *Linn.*, on the sea-beach, and only a few yards away from *TRITICUM JUNCUM*, *Linn.*, on shell-sandy banks immediately above the sea-beach.

CLASS III.—CRYPTOGAMS.

POLYSTICHUM LONCHITIS, *Roth.*—Clefts of rocks on hill-side, 880 feet above sea-level, Wart Hill, Hoy, 3rd October 1913, H. H. Johnston. Native. Very rare ; fifteen plants only seen by me on the above-mentioned date. Removes "[111 Orkney]" from the "supposed errors" in Watson, "Top. Bot.," ed. ii., p. 513. See "Scot. Nat.," No. iii., new series, January 1884, p. 112 ; and Bennett, "Suppl. Top. Bot., ed. ii.," 1905, p. 111.

LASTREA DILATATA, *Presl*, var. *ALPINA*, *Moore* (*vide* J. T. I. B. Boswell).—Stenness. Mainland, 6th August 1875, H. H. Johnston. Native. See "Scot. Nat.," No. iii., new series, January 1884, p. 113.

NOTES ON SOME RARE OR INTERESTING ORKNEY PLANTS.

By Colonel H. H. JOHNSTON, C.B., D.Sc., F.R.S.E., F.L.S.

(Read 15th January 1914.)

This paper contains some notes on twenty-seven species and varieties of Orkney plants collected by me, but not mentioned in my other paper, "Additions to the Flora of Orkney, as recorded in Watson's 'Topographical Botany,' second edition," communicated to the Botanical Society to-day. Of these 27 species and varieties, 25 are native, 1 is naturalised, and 1 is cultivated. The two varieties of *CHARA FRAGILIS*, *Desv.*, mentioned in the following list are new records for H. C. Watson's county 111 Orkney, and they are recorded in this paper because the *CHARACEÆ*

are not included in Watson's "Topographical Botany," second edition.

The nomenclature followed is that of "The London Catalogue of British Plants," tenth edition, 1908.

The abbreviations used are the same as those mentioned in my other paper referred to above.

CLASS I.—DICOTYLEDONS.

RANUNCULUS BAUDOTII, *Godron* (*fide* J. T. I. B. Boswell and J. Groves).—Mud at bottom of shallow water in a loch 40 feet above sea-level, Loch of Burness, Westray, 13th July 1883, and 27th August 1913, Henry Halcro Johnston. Native. Plants with and without floating leaves. Remarks by Mr. James Groves on the specimens collected by me on 27th August 1913:—"Type, I think, the carpels are more numerous than those of the other plants" (from the Loch of Saint Tredwall, Papa Westray) "and are quite glabrous." See "Annals Scot. Nat. Hist.," July 1895, p. 175, in which magazine I first recorded this species from Orkney in the Loch of Brue, Lady, Sanday, 9th July 1883, and Loch of Burness, Westray, 13th July 1883—Also in mud at bottom of water in a loch 8 feet above sea-level, Loch of Saint Tredwall, Papa Westray, 4th September 1913. Native. A new Orkney station discovered on the above-mentioned date by H. H. Johnston. Plants with and without floating leaves. Many detached portions of plants, broken off by the waves and drifted by the wind, were still growing, floating in shallow water among stones and gravel and mud at the edge of the loch, with the flowers in full bloom, giving one on first inspection the erroneous impression that these detached portions were entire plants growing in their natural habitat. Mr. James Groves doubtfully refers my Papa Westray specimens to the *var. CONFUSUS* (*Godron*), and makes the following remarks on them:—"Carpels slightly hairy and less numerous than with the plants from the Loch of Burness, Westray."

RANUNCULUS FLAMMULA, *Linn.*—Stony loch-foreshore, 50 feet above sea-level, Loch of Kirbister, Orphir, Mainland, 30th June 1913, H. H. Johnston. Native. Common. Plants stunted in growth through prolonged drought leaving the loch-foreshore uncovered with water. Stem decumbent,

or rarely at first procumbent and rooting at one node and then decumbent. Mr. Arthur Bennett and the Rev. E. S. Marshall, to whom I sent specimens, are unable to refer them to any named variety of this species.

VICIA CRACCA, *Linn.*.—Common on grassy cliffs at the seashore, 40 feet above sea-level, east side of Aith Hope, South Waas, Hoy, 21st July 1913, H. H. Johnston. This common weed of cultivation is almost confined to cultivated land and its borders in Orkney; but at Aith Hope numerous plants were growing like true natives on the grassy cliffs. Other plants of the same species, however, were growing in an oat-field within 15 yards of the cliffs, and, in my opinion, it is probable that the plants on the cliffs have sprung from seeds derived from plants growing in the cultivated land in the immediate neighbourhood.

ROSA CANINA, *Linn.*, var. *LUTETIANA* (*Léman*) (*vide* J. G. Baker).—Crags at burnside, Wart Hill, Hoy, 28th August 1883, H. H. Johnston; rare on banks at burnside, 240 feet above sea-level, The Dale, between the Hill of Miffia and Cringla Field, Stromness, Mainland, 26th August 1912, H. H. Johnston; and common on grassy cliffs at the seashore, 10 feet above sea-level, west side of Aith Hope, Waas, Hoy, 4th August 1913, H. H. Johnston. Native at all these stations. Remark by Mr. J. G. Baker:—"R. *LUTETIANA*, *Léman*, is identical with the typical *CANINA* of the Linnean herbarium."

CALLITRICHE AUTUMNALIS, *Linn.*.—Mud at bottom of water in a loch, Loch of Skaill, Sandwick, Mainland, 19th August 1881, H. H. Johnston; plants drifted on loch-shore, Loch of Harray, Harray, Mainland. 13th November 1883, H. H. Johnston; and mud at bottom of water in a reservoir 285 feet above sea-level, Reservoir, Stromness, Mainland, 14th October 1913, H. H. Johnston. Native at all these stations. This species has been recorded from 28 of Mr. H. C. Watson's 112 vice-counties in Great Britain. See "Scot. Nat.," No. xlviii., October 1882, p. 364.

[*CICHORIUM INTYBUS*, *Linn.*.—Hay-field, 50 feet above sea-level, Melsetter, Waas, Hoy, 11th August 1913, H. H. Johnston. Not native. Mr. Robert Cutt informs me that seeds of the Chicory were sown in May 1912 to improve the pasture for cattle and sheep.—Also in a grass-field 30 feet above

sea-level, Chalmersquoy, Westray, 1st September 1913, H. H. Johnston. Not native. Mr. Murdoch Balfour informs me that Chicory seeds along with those of clover and rye-grass were sown in May 1911 for pasture for cattle. As the Chicory has never before been recorded from Orkney, I have reported its introduction into the county as a cultivated plant in case it may become naturalised hereafter, and, if so, there will thus be a definite record of the exact manner of its first introduction into Orkney.]

HIERACIUM SCOTICUM, *F. J. Hanbury*, in "Journ. Bot.," vol. xxvi., 1888, p. 106.—Craggs on hillside, 270 feet above sea-level, North Hill, Westray, 15th July 1883 (*vide* *F. J. Hanbury*), and 28th August 1913, H. H. Johnston; very rare on grassy cliffs at the seashore, 15 feet above sea-level, Hangaback, Gyre, Orphir, Mainland, 18th August 1885, H. H. Johnston (*vide* *F. J. Hanbury*; the same specimen was doubtfully identified as "*H. GOTHICUM*, *Fries*," by the late Dr. J. T. I. B. Boswell, who informed me that, if it was not that species, he did not know what it was; see *H. GOTHICUM*, *Fries*, in "Scot. Nat.," No. xlviii., October 1882, p. 370; and *H. SCOTICUM*, *F. J. Hanbury*, in "Annals Scot. Nat. Hist.," July 1895, p. 177); crags at burnside, 240 feet above sea-level, Sowa Dee, Sandwick, and one plant only on the Stromness side of the burn which forms the boundary between the parishes of Sandwick and Stromness, Mainland, 26th August 1912, and 15th July 1913 (*vide* *E. F. Linton*), H. H. Johnston; cliffs at the seashore, 10 feet above sea-level, east side of Aith Hope, South Waas, Hoy, 21st July 1913, H. H. Johnston (*vide* *E. F. Linton*); grassy cliffs at the seashore, 10 feet above sea-level, west side of Aith Hope, Waas, Hoy, 4th August 1913, H. H. Johnston (*vide* *E. F. Linton*); and seen growing by me rare on rocky crags on hillside, 310 feet above sea-level, Vins Hamar, Fitty Hill, Westray, 5th September 1913, H. H. Johnston. Native at all these stations. I did not collect specimens at Vins Hamar.

PYROLA ROTUNDIFOLIA, *Linn.*—Rousay, August 1869, Miss G. Gold (*vide* *J. T. I. B. Boswell*); and Rousay, 30th July 1881, James Reid (*vide* *J. T. I. B. Boswell*). Native. See "Scot. Nat.," No. xlviii., October 1882, p. 371; "Scot. Nat.," No. xiii., new series, July 1886, p. 319; and "Annals

Scot. Nat. Hist.," July 1895, p. 179.—Also on a heathery hillside, 320 feet above sea-level, south-east of the Dwarfie Stane and between it and the Dwarfie Hamars, Hoy, 22nd July 1912, H. H. Johnston. Plants in full bloom. Native.

GENTIANA CAMPESTRIS, *Linn.*—Sandy links at the seashore, 20 feet above sea-level, Links of Melsetter, Waas, Hoy, 11th August 1913, H. H. Johnston. Native. Calyx 4-cleft. Corolla 4-cleft. Stamens 4. Stigmas 2. Mr. Arthur Bennett, to whom I sent specimens, furnished me with the following remark:—"I suppose a state of *G. BALTICA*, *Murbeck*, but I am not sure."—Also in pasture near the seashore, 30 feet above sea-level, Point of Huro, Westray, 2nd September 1913, H. H. Johnston. Native. Calyx 4-cleft, with the two outer lobes much larger than the two inner lobes. Corolla 4-cleft. Remarks on my specimens by Mr. Arthur Bennett:—"It is probable that these specimens are *GENTIANA BALTICA*, *Murbeck*, which he places as a subspecies (not a species) of *G. CAMPESTRIS*, *Linn.* But they are not in a condition to make it sure they are so. As a rule, seaside specimens of *G. CAMPESTRIS*, *Linn.*, may be called *G. BALTICA*, *Murbeck* (but like every rule it has exceptions), and the inland ones *G. CAMPESTRIS*, *Linn.*"

VERONICA CHAMÆDRYS, *Linn.*—Introduced at house-side, Swanbister, Orphir, Mainland, 6th July 1883, H. H. Johnston (*vide* J. T. I. B. Boswell); and very rare on a turf wall 120 feet above sea-level, near Galaha, Smoogro, Orphir, Mainland, 19th July 1912, H. H. Johnston. Not native at either of these two stations, and it is probable that this species is not a true native in Orkney. See "Scot. Nat." No. xlviii., October 1882, p. 372.

BARTSIA ODONTITES, *Huds.* (= *B. ODONTITES*, *Huds.*, var. *a. VERNA*, of "The London Catalogue of British Plants," seventh edition).—Roadside, Naversdale, Orphir, Mainland, 13th August 1880, H. H. Johnston (*vide* J. T. I. B. Boswell); pasture, Binscarth Burn, Firth, Mainland, 21st August 1880, H. H. Johnston (*vide* J. T. I. B. Boswell); wet pasture, Aikerness, Evie, Mainland, 27th July 1883, H. H. Johnston (*vide* J. T. I. B. Boswell); oat-field and pasture at its border, 45 feet above sea-level, Noltland Westray, 27th August 1913, H. H. Johnston; and artificial

pasture, 80 feet above sea-level, Sheepheight, Papa Westray, 9th September 1913, H. H. Johnston. A weed of cultivation, and it is probable that this species is not a true native in Orkney.

UTRICULARIA MINOR, *Linn.*—Harray, Mainland, 18th August 1879, H. H. Johnston (*vide* J. T. I. B. Boswell; see Watson, "Top. Bot.," ed. ii., p. 333; and "Scot. Nat.," No. xlviii., October 1882, p. 374); and shallow pool in a swamp 160 feet above sea-level, at the foot of the north-north-west slope of Cringla Field, just on the Sandwick side of the boundary between the parishes of Sandwick and Stromness, Mainland, 26th August 1912, H. H. Johnston (name confirmed by Mr. Arthur Bennett; see "Bot. Exch. Club Report," 1912, p. 273). Native at both these stations.

ATRIPLEX PATULA, *Linn.*, *var. ANGUSTIFOLIA* (*Sm.*), (*vide* Arthur Bennett).—Stony ground near top of cliffs at the seashore, 80 feet above sea-level, Vaval, Westray, 21st August 1913, H. H. Johnston. Native. Remarks by Mr. Arthur Bennett:—"ATRIPLEX is a very difficult genus to name, but I think your specimens may be named *A. PATULA*, *Linn.*, *f. MARITIMA*; the cusps of the leaves are badly developed, but what there is are evidently straight, not descending as in *A. HASTATA*, *Linn.*, and *A. DELTOIDEA*, *Bab.*"

JUNIPERUS SIBIRICA, *Burgsdorf* (= *J. NANA*, *Willd.*).—This species is common in the island of Hoy, but it is very rare in Mainland, where I have seen and collected specimens from three plants only growing at three different stations, viz. heath, 15 feet above sea-level, between Barnorrie and the Fidge, Swanbister, Orphir, 17th December 1883, H. H. Johnston (*vide* J. T. I. B. Boswell; discovered on the above-mentioned date by Mr. W. A. Irvine Fortescue); heathery hillside, 320 feet above sea-level, Erne Toog, Stromness, 29th October 1913, H. H. Johnston; and heathery hillside, 400 feet above sea-level, Hill of Lynedardy, Stromness, 29th October 1913, H. H. Johnston. Native at all these stations. The plant on the Hill of Lynedardy was in fruit, but there were neither flowers nor fruit on the plants at the other two stations. The late Mrs. Isabella Hiddleston of Houton informed me that the Juniper formerly grew at

Chinglebraes, Saint Ola, Mainland, but it has been long extinct there through the land on which it grew having been cultivated. Dr. James Grant informs me that the Juniper grows at Mousland, Stromness, Mainland; and Mr. Robert C. Tait also told me that he has seen a few more plants of this species growing on other parts of the hills in Stromness parish.

CLASS II.—MONOCOTYLEDONS.

ORCHIS INCARNATA, *Linn.* — Boggy ground near the Dwarfie Stane, Hoy, 7th July 1877, H. H. Johnston (*vide* J. T. I. B. Boswell); pasture, Bay of Islands, Loch of Harray, Stenness, Mainland, 26th June 1883, H. H. Johnston (*vide* J. T. I. B. Boswell; sepals and petals white, see "Annals Scot. Nat. Hist.," July 1895, p. 180); and rare in a marsh 60 feet above sea-level, Kirbister, Orphir, Mainland, 2nd July 1912, H. H. Johnston (stem hollow, sepals and petals pink and marked with dark crimson lines and spots). Native at all these stations. See "Journ. Bot.," vol. xxxix., August 1901, p. 272; and Bennett, "Suppl. Top. Bot., ed. ii.," 1905, p. 79.

POTAMOGETON NATANS, *Linn.* (*vide* Arthur Bennett).

P. HETEROPHYLLUS, *Schreb.* (*vide* Arthur Bennett).

P. PERFOLIATUS, *Linn.*, var. CORDATO-LANCEOLATUS, *Mert. et Koch* (*vide* Arthur Bennett; leaves 1½ to 3 inches long).

P. PECTINATUS, *Linn.* (*vide* Arthur Bennett). — These four native species of POTAMOGETON were growing in mud at the bottom of water, 4 to 6 feet deep, in a loch 51 feet above sea-level, Loch of Boardhouse, Birsay, Mainland, 29th September 1913, H. H. Johnston; and they are all remarkable in having neither flowers nor fruit on them, although in the same loch, at the same time, in water 5 feet deep, MYRIOPHYLLUM SPICATUM, *Linn.* (*vide* Arthur Bennett), was flowering and fruiting copiously. Specimens of P. NATANS, *Linn.*, neither in flower nor fruit, were also collected from the Loch of Boardhouse, in July 1885, by Mr. W. A. Irvine Fortescue, and on 9th September 1885 by H. H. Johnston; and these specimens were identified as "P. POLYGONIFOLIUS, *Pourr.*, var.," by the late Dr. J. T. I. B. Boswell, but Mr. Arthur Bennett, in the "Bot. Exch. Club Report,"

1885, p. 135, writes as follows, with reference to the specimens collected by Mr. W. A. Irvine Fortescue and H. H. Johnston in 1885:—"I have little doubt that this has been seen by Dr. Boswell, yet I cannot but say I should place it under NATANS in the absence of fruit to decide its position." Mr. Arthur Bennett is still of the same opinion with reference to the specimens collected on 29th September 1913 by H. H. Johnston.

**ELODEA CANADENSIS*, *Michx.* (= *ANACHARIS ALSIN-ASTRUM*, *Bab.*).—Stagnant water in an old quarry, near Inganess Cottage, Saint Ola, Mainland, 5th May 1884, H. H. Johnston (*vide* J. T. I. B. Boswell). Naturalised. Plants neither in flower nor fruit. Extinct in this quarry on 13th September 1913. See "Annals Scot. Nat. Hist.," July 1895, p. 180—Also growing plentifully in mud at bottom of water in a quarry 250 feet above sea-level, Berstane, Saint Ola, Mainland, 13th September 1913, H. H. Johnston. Naturalised. Female plants only collected, in flower with the corolla-tube reaching a length of $5\frac{1}{2}$ inches and $7\frac{1}{4}$ inches. Mr. Arthur Bennett informs me that "the male plant has only been found near Edinburgh" in Scotland. The *E. CANADENSIS*, *Michx.*, was probably accidentally introduced into Orkney by Mr. William Cowan, who informs me that he brought plants of this species in a tank to Inganess Cottage in 1869, for microscopic purposes, and that he used the same bottles for holding portions of this plant as for collecting specimens of other aquatic plants from the old quarry in which the *E. CANADENSIS*, *Michx.*, was first found growing in Orkney. The other quarry in which this species at present grows is also in the neighbourhood of Inganess Cottage. I have not found the Water-Thyme elsewhere in Orkney, but it is not unlikely to spread to other parts of the county, if it has not done so already.

ELEOCHARIS PALUSTRIS, *Roem. et Schult.* (name confirmed by Arthur Bennett).—Shallow pool of fresh water 160 feet above sea-level, south-south-west of the Established Church Manse, South Waas, Hoy, 23rd July 1913, H. H. Johnston. Native. Common in the pool. Lowest glume half surrounding the spike. Remark by Mr. Arthur Bennett:—"Nice specimen showing creeping rootstock

well." This species is common in Orkney, but I exhibit a specimen for comparison with *E. UNIGLUMIS*, *Schultes*, which is rare in Orkney.

ELEOCHARIS UNIGLUMIS, *Schultes* (name confirmed by Arthur Bennett).—Water-channel in a marsh near the sea 5 feet above sea-level, Myres Bay, South Waas, Hoy, 19th July 1913, H. H. Johnston. Native. Common in the marsh. Lowest glume almost surrounding the spike. Remark by Mr. Arthur Bennett:—"Nice specimen showing well, especially the younger stems, the character of *UNIGLUMIS*." This species was first recorded from Orkney by the late Dr. J. T. I. B. Boswell, who found it in the Fidge, Swanbister, Orphir, Mainland, where the low-lying marshy ground is liable to be flooded with sea water during high spring tides. See "Scot. Nat.," No. ii, new series, October 1883, p. 72. The Rev. E. S. Marshall also records it as 'plentiful on the south side of Loch Stenness,' Stenness, Mainland, in which loch the water is brackish. See "Journ. Bot.," vol. xxxix., August 1901, p. 273.

CAREX OEDERI, *Retz*, *var. OEDOCARPA*, *And.* (= *CAREX FLAVA*, *Linn.*, *var. MINOR*, *Townsend*).—Marsh, near North Dam, Hoy, 9th August 1886, H. H. Johnston (*vide* F. Townsend; see "Annals Scot. Nat. Hist.," July 1895, p. 181); and stony loch-shore, Loch of Kirbister, Orphir, Mainland, 30th June 1913, H. H. Johnston (*vide* Arthur Bennett). Native at both stations.

CLASS III.—CRYPTOGAMS.

CHARA FRAGILIS, *Desv.*, *var. CAPILLACEA*, *Coss. et Germ.* (*vide* J. Groves).—Mud at bottom of stagnant water in a shallow pool 10 feet above sea-level, Rotten Loch, Brims, Waas, Hoy, 4th August 1913, H. H. Johnston. Remark on my specimens by Mr. James Groves:—"I refer this to *var. CAPILLACEA*, *Coss. et Germ.*, but the primary cortical cells are larger than usual."—Also growing in mud at bottom of water in a quarry 120 feet above sea-level, Kirkbrae, Westray, 1st September 1913, H. H. Johnston. Native at both stations. A new record for H. C. Watson's county 111 Orkney.

CHARA FRAGILIS, *Desv.*, *var. BARBATA*, *Gunt.* (*vide* J. Groves).—Mud at bottom of stagnant water in a quarry

230 feet above sea-level, Berstane, Saint Ola, Mainland, 13th September 1913, H. H. Johnston. Native. A new record for H. C. Watson's county 111 Orkney.

CHARA ASPERA, *Willd.*, var. SUBINERMIS, *Kuetz.* (*vide* J. Groves).—Mud at bottom of water 5 feet deep in a loch 51 feet above sea-level, Loch of Boardhouse, Birsay, Mainland, 29th September 1913, H. H. Johnston. Native. Very common in the loch. Remark on my specimens by Mr. James Groves:—"On some stems the spine-cells are fairly long and numerous."

CHARA BALTICA, *Bruzel* (*vide* J. Groves).—Mud at bottom of brackish water in a loch at sea-level, Bay of Voy, Loch of Stenness, Sandwick, Mainland, 20th August 1912, H. H. Johnston. Plant slightly fœtid. See "Bot. Exch. Club Report," 1912, p. 302.—Also growing in mud at bottom of brackish water in the same Loch of Stenness, near the noust of Nether Bigging, Stenness, Mainland, 4th October 1913, H. H. Johnston. Plant fœtid. Native at both stations, which are 3½ miles apart. This species was first found in Orkney, in the Loch of Stenness, on 13th July 1900, by the Rev. E. S. Marshall and Mr. W. A. Shoolbred, and in the same loch, on 31st August 1900, by the late Mr. F. C. Crawford. See "Journ. Bot.," vol. xxxix., August 1901, p. 275; and "Transactions of the Botanical Society of Edinburgh," vol. xxii., 1901-1904, p. 13.

THE PHARMACOPOEIA OF THE BOTANICAL PHYSICIAN
EIGHTY YEARS AGO. By The Hon. WILLIAM RENWICK
RIDDELL, B.Sc., etc.

(Read 13th November 1913.)

In early times in Upper Canada there was a dearth of regularly educated physicians. It was not easy for a professional man to make a living by his practice; except in the towns, patients were few and generally poor. But there was no scarcity of those who undertook to cure the sick. The place of the regular physician was not infrequently filled by the Herb Doctor, the "Yarb Doctor," as he generally called himself. Most of these came from

the United States, few remained long in the same place, and they were generally ignorant quacks — although occasionally a man of real genius in the treatment of disease was to be found amongst them. Not a few were of the Thomsonian School, of which the founder was Samuel Thomson, born before the American Revolution in what is now New Hampshire (*n.* 1769, *ob.* 1843). He patented some of his medicines, which are not yet completely forgotten, and which seem to have met with a ready sale.

In 1832, at Hamilton in Upper Canada, was published a small volume of 120 small octavo pages which purports to contain his practice of medicine, except what he reserved to be taught orally to those who bought the right to use his system. His theory was that "medicines suited to every disease grow spontaneously on our native soil," and that these "are better suited to our constitution."

In this book he names the plants he employs, and gives their qualities and the method of applying them.

I propose in this paper to give an account of the pharmacopoeia. I italicise the names Thomson uses, and in giving the botanical equivalents I shall use the names given by Gray in his "Field, Forest, and Garden Botany."

RANUNCULACEAE.—The only member of this family is the *Golden Seal* or *Ohio Kercuma*, *Hydrastis Canadensis*, recommended as a very pleasant bitter and an excellent corrector of the bile.

NYMPHAEACEAE. This is represented by the *White Pond Lily*, *Nymphaea odorata* or *N. tuberosa*; its roots are to be dug up in the fall, washed clean, cut into strips and dried. Being then powdered, it is used as a tea for bowel complaints.

CRUCIFERAE.—The Crucifers appear only in *Mustard*, *Brassica nigra*, "to create an appetite and assist the digesture," and internally for rheumatism, and *Horse-radish*, *Nasturtium Armoracia*, for the same purposes—but this is apt to raise a blister.

RUTACEAE.—This family furnishes *Prickly Ash*, *Zanthoxylum Americanum*, whose bark or berries in wine or spirit make a very good hot bitter; "good for fever and ague, for sleepiness and lethargy, cold hands and feet, and other complaints caused by cold."

ANACARDIACEAE. — The *Sumach*, *Rhus typhina* or *R. aromatica*, claimed by Thomson to be a new article in medicine. A tea made of bark or leaves or berries will “scour the stomach and bowels and is good for stranguary.”

LEGUMINOSAE. — *Red Clover*, *Trifolium pratense*. The heads are boiled for an hour, strained, and pressed to get out all the juice, “then simmer over a slow fire till it is about the consistency of tar, when it is fit to use. Be careful not to let it burn . . . spread on a piece of bladder split and made soft. It is good to cure cancers, sore lips, and all old sores.”

ROSACEAE. — This family has several representatives. In the Rose family proper we find the *Evan Root* or *Chocolate Root*, *Geum rivale*, used also to “scour out the stomach and bowels,” but some use it as a drink instead of tea or coffee.

In the Rose family proper is also found *Red Raspberry*, *Rubus triflorus* or *R. strigosus*. The leaves only are used; a tea made of them is good for children with the summer complaint and for women in labour, as well as for the new-born child.

The Pear subdivision also supplies members; *Peach*, *Prunus* (*Amygdalus*) *Persica*. Only the meat of the peach stones is used; made into a cordial it will “recover the natural tone of the stomach after long sickness” and “restore the digesture,” while used as a tea it is invaluable for “young children with the cholic.”

Wild Cherry Stones (*Prunus Pennsylvanica* or *P. pumila* probably is meant) may be used in the same way as peach stones. The cherries themselves, steeped in hot water, after being pounded up with the stones, make a good tea; sweetened with loaf sugar with a little brandy added they create an appetite and restore the digestive organs. (*Bitter Almonds* may be used when Peach or Cherry stones cannot be procured, but that tree is not native.)

HAMAMELACEAE. — This family gives only *Witch hazle*, *Hamamelis Virginica*. The leaves made into a tea is the best thing for bleeding at the stomach the writer has ever found, and he used it also for injections in “complaints of the bowels.”

UMBELLIFERAE.—But one representative of the Parsley family appears, *Archangel*, *Archangelica atropurpurea*, a good corrector of the bile.

ARALIACEAE.—The celebrated ginseng, called by Thomson *Gensung*, belongs to this family; *Aralia quinquefolia*, a nervine; the root should be dug up in the fall, dried, and reduced to a fine powder; a dose—a half to a teaspoonful.

RUBIACEAE.—*Clivers*, better known as cleavers or goose-grass, *Galium Aparine*, a diuretic.

VALERIANACEAE.—*American Valerian*, *Valeriana sylvatica*, “the best nervine known . . . in all cases of nervous affection and in hysterical symptoms.” The roots are to be dug up, washed clean, carefully dried and reduced to a fine powder, administered half a teaspoonful at a time, repeated if necessary.

COMPOSITAE.—As was to be expected, the Composite family is largely drawn upon.

Squaw-weed, *Senecio aureus*. The green roots and leaves are bruised. hot water poured on them; give this as a tea, and it is effective for “canker rash,” rheumatism, and nervous afflictions. Thomson calls this plant also *Frost-weed*, but in Ontario the *Helianthemum Canadense* goes by that name.

Elecampane, *Inula Helenium*. The root, made into a syrup, is good for a cough. In my youth this was supposed to be a good “horse-medicine.”

Maryweed, *Maruta Cotula*. “A tea made of this herb, to be drank hot when going to bed, is very good for a cold.”

Wormwood, *Artemisia Absinthium*, makes a very wholesome bitter. A tea or the green herb tinctured in spirit “is good to apply to a bruise or a sprain.”

Tanzy, *Tanacetum vulgare*, made into a tea, is good for hysterics and other female complaints, also for a “stranguary”; the green leaves powdered are good for “bruises and sprains.” Apparently its alleged virtues as an abortifacient and ecbotic had not then been discovered.

Chamonile, *Anthemis nobilis* (and perhaps *A. arvensis*), made into a tea, is good for bowel complaints; used externally, it will relieve “sprains, bruises and swellings, and remove callouses, corns, etc., and restore shrunk sinews.”

Burdock, *Lappa officinalis*. The leaves wilted by the fire

will allay inflammation; they are good pounded and applied to a bruise or a sprain and make excellent strengthening plasters.

Thoroughwort, *Eupatorium perfoliatum*, made into a tea, is good for a cough and complaints of the lungs.

Featherfew, *Chrysanthemum* (*Leucanthemum*) *Parthenium* or *Pyrethrum Parthenium*, is "good for histeric complaints," and is diuretic

Golden Rod, *Solidago nemoralis* and *S. rigida*. The oil made into an essence is good for pain in the head.

Wild Lettuce, *Lactuca Canadensis*. The roots, powdered, are good to restore weak nerves.

Bitter Thistle, *Silybum Marianum*, made into a tea, is a good corrector of the bile, and so is *Cardis benedictus* or *beloved thistle*. This is as near as the author could get to *Carduus benedictus*, the *Cnicus benedictus*, or blessed thistle.

LOBELIACEAE. — This family supplies the crowning glory of Thomson's system, *Lobelia* or *emetic herb*, *Lobelia inflata*, whose virtues are claimed as his original discovery, and which was No. 1 in his system of medicine. All parts were used, powdered leaves and pods, the green herb in tincture, and the seeds powdered. It was employed in every disease, either as an emetic or in the form of a clyster.

ERICACEAE. — *Pipsisway* or *Rheumatic Weed*, *Chimaphila umbellata*. Roots and tops made into a strong tea are "good for cancers and all scrofulous humours by drinking the tea and bathing with it the parts affected."

SCROPHULARIACEAE. — *Bitter-herb* or *Bulmony*, *Chelone glabra*. Used as a tea, "this herb is very good to correct the bile and create an appetite."

PLUMBAGINACEAE. — *Marsh Rosemary*, *Statice Limonium*. The root is good for canker and sore mouth.

Mullen, *Verbascum Thapsus*. The leaves pounded and applied warm are "very good to bring down swelling and to restore contracted sinews."

VERBENACEAE. — Both *Blue Vervine*, *Verbena hastata*, and *White Vervine*, *V. urticifolia*, are highly thought of, ranking next to lobelia itself "for a puke," and also being good to prevent a fever in its first stages. The herb has

also cured several cases of consumption "where the doctors had given them over."

LABIATAE.—*Spearmint*, *Mentha viridis*, given as a tea, stops vomiting.

Peppermint, *Mentha piperita*, promotes perspiration and relieves pain in the stomach and bowels.

Peneroyal, *Hedeoma pulegioides*, "may be freely used in all cases of sickness: it is good for the stomach . . . it will produce perspiration and remove obstructions."

Summer Savory, *Satureia hortensis*, is good for colds; and the oil will cure toothache.

Hoarhound, *Marrubium vulgare*, is good for a cough. "An infusion made of the leaves, sweetened with honey, is good for the asthma and all complaints of the lungs," while "hoarhound candy is very useful . . . for old people and those that are short-winded."

SOLANACEAE.—*Capsicum*, *Capsicum annuum*, ground to a powder, forms No. 2 of the system, and is given to "strengthen the digesture." but externally it is "good to put on old sores."

Bitter-sweet, *Solanum Dulcamara*, Thomson uses only externally, and finds it, made into an ointment, "an excellent thing for a bruise, sprain, callous, swelling or for corns."

ASCLEPIADACEAE.—*Bitter-root* or *Wandering Milkweed*, of two kinds, *Asclepias phytolaccoides* on moist ground and *A. verticillata* on dry. The roots only are used, dried and pounded in a mortar: while they are very bitter, they are an excellent medicine to remove costiveness and correct the bile.

ARISTOLOCHIACEAE.—*Snakeroot*, *Asarum Canadense*. To be made use of "in tea for measles and other eruptions to keep the disorder out," also "for all nervous complaints." That *Asarum* is the "snakeroot" meant, and not *Eupatorium ageratoides*, which is also popularly called snakeroot, is clear from Thomson's description of it as of a hot nature, thus identifying it with Canada Wild Ginger, or *Asarum*.

POLYGONACEAE.—*Yellow Dock*, *Rumex Crispus*. The root made into an ointment with cream, rubbed in at bedtime, will cure the itch.

URTICACEAE.—*Slippery Elm*, *Ulmus fulva*. The inner bark is dried and ground, a teaspoonful of the powder is

put into a teacup, a little cold water added, stirred until perfectly mixed, then hot water added and stirred till a jelly is formed. The jelly is an excellent medicine for sore throat; the bark also is used for poultices, for burns, scalds, old sores, etc. Half a century ago I have seen the inner bark fresh from the tree boiled into a jelly and the jelly given for colds and sore throat.

JUGLANDACEAE.—*Butternut*, *Juglans cinerea*. The bark boiled down thick makes good pills for emetic and cathartic purposes; or a syrup made by boiling the bark with molasses and a little spirit may be given to children for worm complaints. "The bark of the butternut is the principal ingredient in Dr. Hawkes' rheumatic and cancer pills, and also of Chamberlain's bilious cordial, which have been so celebrated for many complaints."

MYRICACEAE.—*Bayberry* or *Candleberry*, *Myrica cerifera*. The bark of the root dried and powdered is "highly stimulating and very pungent, pricking the glands and causing the saliva and other juices to flow." It is the chief source of Thomson's No. 3.

Meadow Fern, *Comptonia asplenifolia*. The "burr pounded fine and simmered in cream, hog's lard, or fresh butter, is almost a sovereign remedy for the itch or external poison and all bad humour sores," also "for salt rheum or canker sores."

BETULACEAE.—*Black Birch*, *Betula lenta*. The bark, used as a tea, is used for dysentery and all complaints of the bowels.

SALICACEAE.—The *White Poplar*, *Populus alba*, and the *Stinking Poplar*, *P. balsamifera*, belong to this family. The inner bark is taken off trunk, limbs, or root, dried, and used as a tea for "headache, faintness at the stomach . . . and those of a consumptive habit will find great relief in using this tea freely." It is also a valuable diuretic.

Balm of Gilead, *P. balsamifera* (var. *Canadensis*), may be used in the same way, but "it is more harsh than the other kinds of poplar." It is good taken inwardly, as a restorative, is a good corrector of the bile, and will operate both as an emetic and cathartic, while externally it is used for bathing sores.

CONIFERAE.—*Balsam Fir*, *Abies balsamea*, produces the

Canada balsam from small blisters in the bark. This is good to remove internal soreness, and forms an important article in Thomson's healing salve.

Hemlock, *Abies Canadensis*. The inner bark is dried and powdered, made into a tea, and administered for "canker and other complaints of the bowels and stomach." The boughs, made into a tea, are very good for gravel and for rheumatism.

ARACEAE.—*Skunk Cabbage*, *Symplocarpus foetidus*. The root dried and powdered, made into a tea, is good "for asthma, cough, difficulty of breathing, and all disorders of the lungs"

LILIACEAE.—*Wake Robin*, *Trillium erythrocarpum*. The root, dried and reduced to powder, is given with honey or in a syrup; it "is extremely pungent and stimulating and is given for cholic and pain in the bowels and to expel wind . . . for coughs and disorders of the lungs."

The empiric is not quite true to his principles, for he uses a few exotic plants: bitter almonds, ginger, black pepper, cloves, and myrrh. Myrrh, indeed, is the main ingredient in his celebrated medicine, which he calls No. 6.

He is not wholly averse from chemical preparations: sal ammoniac, lime, spirits of turpentine, all appear as remedies.

Products of the animal kingdom he does not discard, butter, honey, beeswax, milk, etc.

Vegetable products are frequently met with—turpentine, rosin, pearlash, etc.: but these may fairly be included in his theoretical category.

The school founded by Thomson¹ afterwards merged in the Eclectic School, and at length has practically disappeared. Many of the Thomsonian remedies are, however, in common use in the farming community to this day.

¹ It must not be thought that all botanical physicians were followers of Thomson; quite the reverse is the fact. Many practised by the light of nature, some relied upon their own experience, while some few had a real medical education.

I have before me a duodecimo volume printed at New York in 1829, "The Improved System of Botanical Medical Practice . . . by William Barber." Barber practised in Vermont and other New England States, then came to Auburn, New York, and finally to New York City. He wholly repudiated Thomson's system. He says: "My preparations are of my own discovery." He pestered the New York Legislature year after year for a license to practise. He was a quack and pretender of the rankest kind.

NOTES ON SOME SCOTTISH PLANTS. By JAMES FRASER.

(Read 13th November 1913.)

The following list of plants, observed during 1913 except where otherwise indicated, consists of several "aliens" new to Britain (these are marked by a star), several new records for vice-counties, and several plants considered sufficiently interesting to have new localities for them put on record.

I am indebted to Mr. Cedric Bucknall of Clifton for examining and determining Symphytums from many localities, and to Professor Hackel and the Director of the Royal Gardens, Kew, for determining several of the grasses.

Erysimum cheiranthoides, Linn., and *Matricaria discoidea*, DC., several of each at Aberfoyle, v.c. 87.

* *Xeranthemum inapertum*, Linn.; * *Diplotaxis Lagus-cana*, DC.; * *Linuria rubrifolia*, Rob. et Cast.; * *Arrhenatherum erianthum*, Boiss. et Reut.; * *Ammochloa pungens*, Desf.; * *Vulpia cynosuroides*, Boiss.; *Lolium rigidum*, Gaud., * var. *ramosum*; several of each (Esparto grass casuals), near Musselburgh, v.c. 83.

Poa Chaixii, Vill., very plentiful, and *Festuca heterophylla*, Lam., scarce, growing together in the Yester grounds, v.c. 82.

Lysimachia punctata, Linn., a clump 6 feet in diameter on the bank of the River Lyne, near Romanno Bridge, v.c. 78.

Symphytum peregrinum, Ledeb. This plant I have already recorded for Wigtownshire and the three Lothians. Since then it has been noticed in six other vice-counties, and there in about thirty different places. For many of these I am indebted to Miss Ella F. Dickie and to Mr. Andrew Templeman, who very kindly undertook to show me any localities in which they might meet with this plant in 1913. The vice-counties where it has been noticed to this date are:—

Dumfries (72). Near Moffat, several.

Wigtown (74). Near Portpatrick, one clump, in 1912.

Lanark (77). Near Kirkfieldbank, plentiful; at Stonebyres, a few.

Peebles (78). In several places near Romanno Bridge; near Broomlee; at and near Slipperfield Loch; several.

Selkirk (79). Near Ashiesteel, one clump, in 1911.

East Lothian (82). Near North Berwick; near East Linton; several.

Midlothian (83). Braid Hills; west of Colinton; Comiston; in fields at Almondbank; by the river at Cramond; at Marchbank; at Bavelaw; in Firth grounds; at Slateford in 1906 and 1913: several in each; and near Gilmerton in immense quantities—the plants, over five feet in height, at one place covering about thirty square yards, at another extending for two hundred yards in an almost continuous strip between two fields.

West Lothian (84). At Carlowrie; west of South Queensferry; two or three.

Fife (85). Near Kilconquhar, plentiful.

East Perth (89). By the Tay below Perth; near Blair Atholl; several.

PHOTOMICROGRAPHY AS APPLIED TO TIMBER STUDY.

By W. S. JONES, M.A., M.Sc. (Plate XIII.)

(Read 12th March 1914.)

Those who have had some experience in the study of the minute structure of timber know all too well the many difficulties of representing by drawing the complex anatomy of dicotyledonous timbers. These difficulties are, without doubt, best overcome by invoking the aid of the camera, and yet how seldom is the art of photography practised in relation to the study of timber structure! Besides being a convenient method of illustration, it is, above all, accurate, entirely eliminating, as it does, the personal element. Imagining the work to be such as can only be conducted in well-equipped laboratories, students leave our colleges for work in forest areas in the colonies and elsewhere deprived of one of the greatest helps in the field of timber

study. Tutors, too, are prone to regard photomicrography as an expensive and tedious business, and are therefore inclined to shun the art. Notwithstanding the prevailing ideas, photomicrography as applied to timber work is an absorbingly interesting and edifying occupation, and withal simple and easily mastered. Writers on the subject are apt to magnify the difficulties and to complicate the apparatus necessary for successful work, thus making the expense, if one accept their estimates, almost prohibitive. Little wonder, then, that few private individuals possess a photomicrographic outfit. Indeed, comparatively few laboratories have such an outfit among their equipment, and where such exists it is often unnecessarily complicated and expensive.

It is with a view to removing some of the misapprehensions regarding this important phase of photography, and to affording simple guidance to those who may require it, that this short article is written.

A comparatively simple, inexpensive apparatus is all that is required, and with it several excellent negatives can be got in an evening. The necessary skill in manipulation is very soon acquired even by those who have no previous knowledge of photography. Neither expense nor difficulty should deter anyone. These observations the writer confidently makes as the result of a fairly wide experience of a simple outfit capable of very good work, and he makes no apology for describing the methods and apparatus which he has for a long time employed.

Preparation of the Timber to be examined.—The timber whose structure it is proposed to study is cut up into convenient cubes and boiled in water for about half an hour. This operation drives out air and softens the blocks. The cubes are then immersed in a mixture of equal parts of glycerine and alcohol. The timber is thus rendered more amenable to further treatment.

Preparation of Sections.—Microtomes specially made for cutting wood sections are very expensive, and for most purposes are unnecessary. Good sections can usually be got without incurring great expense by the use of a suitable hand microtome. The writer uses a microtome which requires the embedding of the material in paraffin

wax. It is desirable, prior to inserting the wax cylinder into the well of the microtome, to make a shallow longitudinal groove in the wax so as to allow the escape of air as the embedded material is pushed in. A further precaution is necessary with this form of microtome. The wax round the upper end of the material should be carefully removed with a sharp knife, at least from the near side (*i.e.* the side which first confronts the razor) of the block. In order to secure good resistance to the razor, the wax on the far side can be advantageously left intact. Other forms of cheap microtomes requiring only the clamping of the wood cubes in position can also be effectively used.

The sections are first placed in strong alcohol in a watchglass, which is then held, by means of a pair of forceps, over the naked flame of a small spirit lamp until the alcohol nearly reaches its boiling point. The air in the section is by this treatment entirely and quickly expelled. Much time is saved by the heating, while the hot alcohol also often removes much of the colouring matter and other substances from the tissues. The sections are then transferred to a watchglass containing pure lactic acid, and held, as before, over a naked flame until bubbles begin to form in the liquid, when the watchglass and contents are removed. Lactic acid, though very seldom used, is a valuable reagent, and, besides having the effect of clearing the sections somewhat, it improves their condition after treatment with strong alcohol. Should the timber be very highly coloured it may, perhaps, be necessary to use some other clearing reagent at the outset, although it may be added that even in such cases alcohol and lactic acid generally suffice.

Staining.—The sections are, after treatment with the acid, transferred to a watchglass containing carbol fuchsin (Ziehl's formula. See Lee's "Microtommist's Vade-Mecum"), where they remain only for a short time. This stain is one of the simplest to use, and one of the most efficient for the purpose of photography. The best strength of fuchsin will be readily ascertained by a few trials. If necessary, add a little dilute alcohol. The sections when stained sufficiently require two or three successive washings in

50 per cent. glycerine. The fuchsin occupying the lumina is thus washed out, and with careful manipulation only the cell-walls are stained.

Mounting of Sections.—After washing, the sections are mounted on a slide in 50 per cent. glycerine, the coverglass being sealed with an easily prepared mixture of equal quantities of gum mastic and paraffin wax (see "The New Phytologist," March 1911). This is a convenient substance for sealing, being very simply applied by means of a slightly heated bent nail mounted in cork. The sections will keep for any length of time, but should there be any conceivable reason for remounting a section the sealing substance can be readily removed.

These operations, apart from the sectioning, although appearing somewhat elaborate, are quickly executed and occupy in all only a few minutes. Moreover, several sections can be treated at the same time.

Microscope.—The magnification desirable for photographing sections of broad-leaved timbers is not usually high. One of from 25 to 120 diameters is generally ample. It is not necessary to possess an elaborate microscope with apochromatic lenses, the ordinary, upright, student's microscope with modern achromatic lenses being all that is required for ordinary work.

Illuminant.—Ordinary coal gas is the most convenient for most workers, and this is quite a satisfactory source of light. A suitable, incandescent, table lamp should be purchased and connected by means of rubber tubing with a gas bracket in the wall or on the bench (Flatters & Garnett manufacture a very convenient inverted lamp with removable chimney). A bull's-eye ($2\frac{1}{2}$ -inch lens) mounted in a ball-and-socket stand should be placed near the lamp, and between it and the microscope, so as to throw the light on to the concave side of the mirror of the latter. The position of the bull's-eye should be so adjusted as to throw the best light on to the mirror, the chimney of the lamp if necessary being removed.

Camera and Accessories.—The writer uses a Browning "Microkam" (lantern size), which he has modified as described below. As the modification adds vastly to the utility of the camera, it is quite worth the few shillings

spent on it. The "Microkam" as sold consists of a well-made, rigid, wooden box, fitted with a hinged dark shutter, and grooved at one end to take the dark slide and focusing screen provided. At the other end is a projecting nozzle intended to fit *into* the microscope tube, but such an arrangement necessitates the removal of the eyepiece, and this greatly reduces the magnification. It is to overcome this drawback that the following modification is desirable (see fig. 1). A short length of thick brass tubing, the outside diameter of which is slightly greater than the milled head of the eyepiece, is fitted to form a collar round the upper end of the microscope tube. The nozzle of the camera must be removed and replaced by another whose internal diameter exactly corresponds to the external diameter of the brass collar fixed to the microscope. By this means the camera can be attached to the microscope without the removal of the eyepiece. This is a great advantage, for the use of the eyepiece obviously ensures a much higher magnification, and compensates for the absence of an extension bellows, while the modification in the camera does not preclude the possibility of working, if desirable, without the eyepiece. It is an advantage to use a screen of ground glass to secure even illumination. A piece the size of a lantern plate answers admirably. It can be fixed underneath the stage by means of an india-rubber band if there be no substage condenser in the way. If the ground glass cannot be so fixed, the screen can be placed with the ground surface downwards on the stage itself. There is little danger of the uneven surface of the glass coming into focus with the section. It is always a safe, and indeed where no eyepiece is used a necessary, procedure to dull the inner surface of the microscope tube by inserting a lining of velvet. To ensure the rigidity of the lining, the velvet is mounted on stiff but flexible paper and rolled into a tube which just fits the microscope tube. The paper, tending, as it does, to unroll, keeps the lining, which, unmounted, would obtrude itself into the field of view, closely applied to the inner surface of the microscope tube. As the camera is firmly attached to the microscope the effect of vibrations is minimised, since the camera and microscope vibrate together. The plates the writer

generally uses are the "Royal Standard" plates by Cadett & Neall.

Exposure.—The slide, when ready, is placed on the stage and the microscope focussed. Great care must be taken to adjust the mirror of the microscope so that the field is perfectly uniformly illuminated; for unless this be carefully done the results will be disappointing. The required portion of the section having been selected, the camera is fixed to the microscope, and the focussing, ground-glass screen placed in position. It will now be found necessary to re-focus so as to have a clear image of the section on the focussing screen. This done, the shutter of the camera is closed, the dark slide slipped into position, and the exposure made. The exposure should, for moderately low magnification, last from two to five minutes, according to circumstances, such as the transparency of the section, intensity of the light, and so on. Immediately the time of exposure has expired, and before closing the dark slide, quickly but gently close down the shutter of the camera. Then push in the sliding face of the dark slide while the latter is still in position. Any modifications necessary to meet special circumstances can, with a little practice, be easily devised.

Developing, Fixing, and Printing.—These operations being precisely the same as in the case of ordinary photography, the reader is referred for guidance to one of the many cheap books now available on the subject. Suffice it to say that, when printing, the part of the negative not required for reproduction should be masked off. Masks are sold by all dealers in photographic requisites in the following two forms: (1) Those which are already cut to shape, and (2) those which can be easily cut into any shape and size. A curved pair of scissors is very useful for cutting circular masks. The mask, when cut into shape, should be stuck on by one corner to the film side of the negative. By this means any number of precisely similar prints can be obtained.

Cost of Apparatus.—All that is absolutely necessary by way of apparatus is included in the following list, with approximate prices appended:—

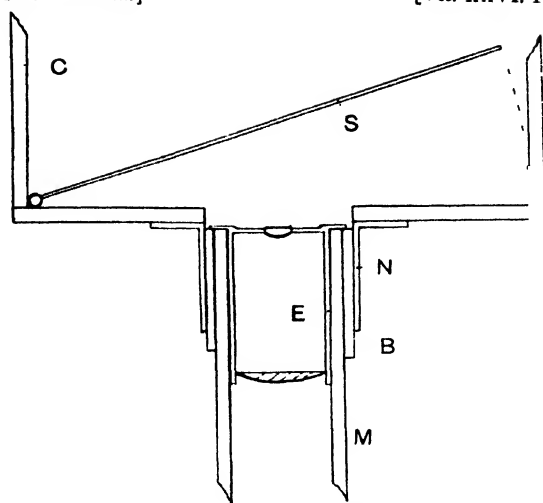


FIG. 1.



FIG. 2.

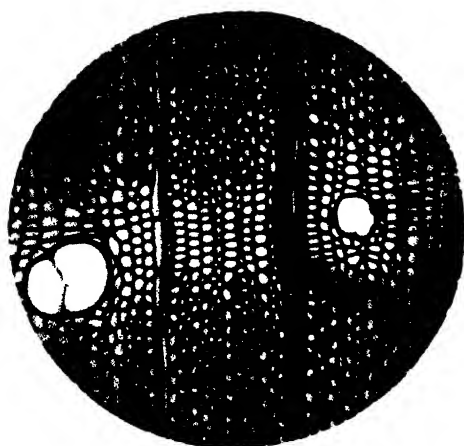


FIG. 3.

"Flatters" Microtome	£2 10 0
Knife	0 4 3
Six Imbedding Tubes	0 2 6
Lamp	0 14 6
Bull's-eye	0 11 6
Microscope	7 10 0
Camera, with nozzle, ¹ screen, and dark slide	1 15 0
Total	£13 7 9
Modification, if adopted, about	0 5 0

A few inexpensive accessories would obviously be advantageous, but these could be purchased as the work developed.

EXPLANATION OF PLATE.

Fig. 1 Section of camera and microscope showing the modification described in the text C, camera; S, shutter; E, eyepiece; N, new nozzle; B, brass collar; M, microscope tube.

Fig. 2 shows the general arrangement of the light, bull's-eye, microscope, and camera.

Fig. 3. Photomicrograph, taken with the apparatus described, of cross-section of stem of *Artocarpus integrifolia*, Linn. f.

ADDITIONAL MOSSES FROM WEST ROSS-SHIRE. By JAMES STIRTON, M.D.

(Read 9th April 1914.)

During the last seven years I have spent considerable periods in various parts of the Western Highlands and Islands, mainly for the purpose of investigating the moss-flora of these otherwise attractive regions. Some time previous to this I had become, through correspondence, interested in parts of the east coast of North America under nearly the same latitude as Great Britain. Even at an early stage of this correspondence I was obliged to confess, in spite of adverse criticism, that there were curious similarities in certain divisions of the cryptogamic botany of these opposite shores and, more recently, that there were

¹ Without nozzle the price is £1, 11s. 6d.

close relationships of certain sections of mosses, such as, more especially, that containing the genus *Campylopus*, as prevalent there, if not more so, than on our western shores. In the "Annals" I have indicated three of these identities. Under the assurance that such a correspondence would continue, I expressed a wish to have species from Nova Scotia or from any of the larger islands in the gulf of the St. Lawrence. With one exception, I failed to obtain any in a satisfactory condition. Accordingly it is possible that one of the species described in this paper may have been represented already by some American botanist hitherto unknown to me. In such circumstances I think it due to myself to give the present explanation.

By way of introduction to this paper I may be allowed to describe certain large cells which, within the last ten years, have played a more important part than formerly in the discrimination of species:—

First.—Large oblong cells, generally, but not always, with thickish walls, either pale or becoming more or less red or brown and then opaque, situated at the base of the leaf either next the margin—the usual situation of the auricles,—or next the nerve, situated almost always in the centre of the leaf.

Second.—Elongato-hexagonal cells with thin walls, in double layers—in other words, one layer of cells on the anterior surface, the other just behind the first. This question of the double layer is difficult of proof.

I have succeeded in convincing myself of this disposition of these cells in three instances where a thin cross-section of the lower part of the leaf was made; but very generally a view of the entire leaf under the microscope is sufficient, if such a cell is viewed at different angles, when the sides will be seen to come closer or recede from one another, more especially as the walls of such cells are almost always parallel. The position of such groups of cells varies as in the others—viz., at the alar or outer margin of the leaf or at the middle base, i.e. with one side of the group in contact with the nerve.

Third.—Another cell plays nearly as important a part as the others, although it is seldom or never seen quite at the base of a leaf, viz. the fusiform, either hyaline or

filled with granules, or a modification of it (the more frequent), viz. undulating or sigmoid in place of straight throughout.

The forms of the other cells are well enough indicated by their names, viz. quadrate, rhomboid, etc. I have left out, meanwhile at least, consideration of other forms of cells, such as sinuose, etc., as they do not occur in the mosses described in this paper.

As already hinted at, I commenced with the *Campylopi* so prevalent in the West of Scotland and assuming so many different forms and appearances.

The first two resemble one another in their internal organisation, but, according to the more modern classification, belong to different sections, inasmuch as the one has the leaves hair-pointed, the other not.

Campylopus Fergussoni (Strn.), n. sp. In rather large lax tufts, green above with a broad pale brown zone just below, dark brown to base; stems slender, simple, or here and there branched, from two to three inches long; leaves with well-marked bulbous bases as well as slightly ovate, lanceolate, longly and slenderly acuminate, with short, slender, hyaline hair-points, apt to fall off as in others with similar apices such as *C. brevipilus*; nerve pale, about half the breadth at base, ultimately brownish, tapering up to the attachment to hair; alar spaces well developed, hollow, often projecting beyond the margin of leaf, as well as extending to nerve, composed of oblong, large cells with thick, red walls, close often attached, .05-.07 by .018-.027 mm.; just above these alae and next to nerve, oblong, hyaline cells, .04-.05 by .012-.016 mm. in several rows, outwards rapidly smaller and narrower until near and at margin very small and hyaline, in many rows, .012-.017 by .003 mm.; upwards becoming abruptly rhomboid, shorter still, smaller outwards, and remaining such to where cells cease: thereafter nerve is predominant; a thin cross-section of nerve reveals the anterior row of close cells, from above downwards, .006-.016 mm. in longer diameter; second row of alternating cells with those of first or anterior, somewhat less in size; third row contains only a minute cell here and there; bulging cells on posterior surface of nerve well developed, hyaline, .005-.01 mm., but

becoming a little less near base; crowds of stereids everywhere rendering bulging cells occasionally obscure or even opaque. No undulating fusiform cells seen, such as prevail nearly throughout in *C. atrovirens*. Near Plockton in several localities, 1913. As a memento of my friend the Rev. John Fergusson of Fern near Brechin, an enthusiastic and successful bryologist.

Campylopus crenulatus, n. sp. In large close tufts of a green or pale green above, a deep brownish-red below; stems from 1 to 2 inches long, upright, mostly simple, occasionally emitting short branches; leaves somewhat expanded at base, lanceolate, longly and slenderly acuminate, hairless, alar spaces large hollow, bulging somewhat beyond margin, defined from the cells above by a well-marked line which slopes upwards and outwards: cells very large, bluntly oblong with pale, thickish, opaque walls, $\cdot 06$ – $\cdot 09$ by $\cdot 022$ – $\cdot 04$ mm., cells just above the alae large, oblong, close, granular with thick walls, $\cdot 05$ – $\cdot 07$ by $\cdot 015$ – $\cdot 02$ mm., smaller upwards; outwards such cells in eight to ten perpendicular rows, oblong as well as hyaline with thin walls, becoming narrower and sloping upwards and outwards until they end in a single marginal row: above this second space cells throughout are bluntly rhomboid, granular, large at first about $\cdot 03$ by $\cdot 009$ mm., lessening upwards into the minute oval or subquadrate cells to apex; nerve strong, nearly half the breadth of base, tapering and scarcely excurrent, but very prominent behind, while apex proper is strongly toothed and shows, besides, two or three teeth on nerve behind near apex. A thin section of nerve shows an anterior row of cells from $\cdot 006$ – $\cdot 01$ mm. near base; second row from $\cdot 007$ – $\cdot 013$ mm. below; no other row manifest behind owing to this space being crammed with stereids to such an extent that no direct light can be transmitted, accordingly the posterior surface of nerve appears smooth except near apex where minute bulgings only perceptible. The whole section of this nerve is darker to transmitted light than any I have ever seen. Near Plockton, Ross-shire, 1913.

This moss differs from *C. Fergussoni* in the absence of hair-points and bulbous bases to the leaves, nerve also scarcely reaches apex, or, if so, is only shortly excurrent.

There are also differences of structure in both nerve and pagina, etc.

Campylopus citrescens, n. sp. In lax tufts of a pale green colour above, which changes in the herbarium to a lemon-yellow, stems short, about half an inch long, almost always simple, leaves nearly upright and straight whether wet or dry, lengthening somewhat in an upward direction, from a slightly ovate base, concave above, having as a rule a few rather strong red radicles at base of leaf as well as very fine red or rather purple tomentum which shows more or less throughout the lower part of the tuft; nerve red at base, including corresponding part of pagina, yellow thereafter, three-fourths breadth of base, tapering and longly excurrent; no auricles at basal margin and leaf narrows there; central basal cells, in two or three perpendicular rows, large, oblong, attached with thick transverse opaque walls, the lateral walls thin, .055-.07 by .013-.017 mm., becoming narrower outwards to margin and hyaline, the latter proceeding farther up the leaf than the others, becoming shorter and showing many bright points but no chlorophyll, such soon cease in single file on the nerve, upwards the nerve is predominant. Plockton, Sept. 1913.

This moss is peculiar in several respects, inasmuch as the nerve is non-cellular in its posterior half and no upper cells are perceptible, in the citrine colour, and in the presence of both kinds of fibrillae.

As regards this moss, I think it right to make known certain phenomena observed in connection with the large red radicles attached not to the nerve, as is almost invariably alleged, but to one of the large cells already alluded to and situated close to the nerve. It was noticed that these radicles had their origin from a large, irregularly oblong, opaque body situated between the double walls of such cells now turned red and thickened. A gentle pressure on this body by means of the glass cover caused it to expand a little. Leaving the whole for two hours, but renewing the moisture three or four times during the interval, I became aware of the darkening of the end opposite to that of the point of attachment of the radicle and of the appearance of a slight notch at its summit, while slender threads were visible here and there over its general surface. Unfortu-

nately beyond this I could not go. I may mention that an old capsule, dark red also, sulcated and nearly erect, on a seta of the same colour, was observed rather close to the stem producing these objects.

The following was found in three places near the base of what are reckoned the highest cliffs in Great Britain.

Bryum rubicundum, n. sp. In very dense convex, widely extended tufts, in one instance 8 inches in longer diameter, of a brilliant wine-red colour throughout; stems upright, red, about 1 inch long, simple but rather frequently fastigiately branched near apex: leaves at first pale green, quickly red, closely arranged around stem, upright, appressed, but often showing a slight contortion when dry, including acumen about 7 mm. long, narrowly lanceolate, pagina joining nerve above at an acute angle, the one side joining at a higher level than the other; nerve strong red, near base about .11 mm. broad, tapering and excurrent in a long, very slender, red, solid acumen, hair-like in upper half, about 3 mm. long, margin reflexed below, composed of three to five rows of very long, narrow cells up to apex, where they join the acumen: cells at base nearly bluntly square, detached, about .023 mm. across, above this group cells elongato-hexagonal, .06-.08 by .012-.017 mm., the rest of cells to apex smaller but of the same shape or acutely rhomboid. I cannot recall having ever seen, in any other *Bryum*, such a long slender acumen, nearly the length of the leaf proper.

Hypnum intortum, n. sp. In rather dense nearly upright tufts, green above, pale brown below, from 2 to 4 inches in height; stems strong, pale, irregularly branched below, densely pinnate above; pinnae short, spreading widely, shortening regularly upwards so that the whole assumes a triangular form, branches ceasing considerably below apex of stem, leaving this part bare; stem leaves very large—three or four times the length and breadth of the branch leaves or nine times their area,—spreading nearly at right angles to the stem, rather abruptly and broadly expanded at base, narrowing also nearly as abruptly into the long, tapering, curved acumen, nerveless, margin plane serrated from base to acumen, and when this acumen is broader than usual, serrated considerably up its margin:

the upper part of main stem (bare of branches) has leaves more abruptly narrowed into the slender acumen, which is often twice the length of leaf proper, and when dry very often assumes a curled or cork-screw appearance, as in *T. tortuosa*; branch leaves much smaller and less expanded at base, spreading also, but otherwise resembling the main stem leaves; cells at basal margin form a fairly well developed group, broadly oblong, detached with thickish walls, .018-.027 by .01-.015 mm.; general cells narrowly oblong but narrowing a little towards the extremities, .06-.08 by .0035-.004 mm.

Only one long, strong, red seta was seen without the capsule, surrounded at its base by pale, sharply pointed, slightly spreading leaves; and on the same stem, within a short distance from the seta another minuter bud, also pale, probably enclosing the male inflorescence. Near Plockton, Ross-shire, 1913.

As I consider the matter one of importance, I make no scruple in calling attention to the next moss. It is known in the field by the dense convex tufts, dark green above with a pale zone just beneath, then of a uniformly dark brown colour to the base, as well as by the leaves with short, almost equal, hair-points. This moss has been under observation for years. In my opinion, it is diverging from *C. atrorivens*. The basal areolation diverges most. Cells next the nerve below, in three to five perpendicular rows, are thick-walled and oblong, .03-.04 by .018-.025 mm.; directly outwards, towards margin, cells become narrower and thinner walled until near and at margin, in many rows, linear and hyaline, .018-.027 by .004 mm. Even the upper cells are somewhat different, nearly linear in place of sigmoid, granular, .028-.045 by .004-.006 mm. The auricles are small (smaller than usual), hollow, and contain only a very few (six to eight) large oblong, attached cells, brown, .04 by .03 mm.

I may have another opportunity for ventilating this subject further. Meanwhile this moss may be named *Campylopus perplexans*, inasmuch as I sympathised with Wilson with regard to another specimen named *C. paradoxus* (Wils.).

THE ECOLOGY OF KNOCKDOW ESTATE, ARGYLLSHIRE.
By Miss AUGUSTA LAMONT. (Map and Plates XV., XVI.)

(Read 12th February 1914.)

Extent and Geographical Position.

The area included under the above title comprises a tract of about 6000 acres in the Cowal district of Argyllshire. Bounded along its western extent by the waters of Loch Striven for a distance of about $4\frac{1}{2}$ miles, and along the greater part of its northern and eastern limits by the watershed of the Inverchaolain Glen, it extends from sea-level to a height of 2005 feet at Cruach nan Capull, the northernmost point. In addition, a detached piece of land, consisting of between 200 and 300 acres situated at Toward Point, is included in the estate. This latter portion of the area has a seaboard of about $1\frac{1}{2}$ miles, and extends inland to an elevation of 600 or 700 feet.

Climate.

The climate of the district is that which is typical of the West Coast generally: an annual rainfall of about 60 inches (58 in 1911) is well distributed throughout the year; frosts are seldom of long duration, and snow rarely lies long except on the hills: in summer drought and excessive heat are practically unknown; in autumn and winter gales from the West and South-west are often of great severity, while East wind frequently predominates during the spring months.

Soil and Geological Formation.

The estate lies almost entirely on the Metamorphic Rocks of the Highlands, and the overlying soil is, to a large extent, of a peaty nature. Part of the Toward Point area, however, lies on the Old Red Sandstone, and alluvial deposits occur on the low-lying ground along the seaboard and in the glens.

From the above brief description it will be apparent that the area is very favourably situated for studying, within a small compass, various types of flora characteristic of the Western Highlands. It is, besides, very thinly populated,

and only a small proportion of the land is under cultivation; and although a portion of the Toward ground is feued, and is therefore left out of consideration for the present purpose, this amounts only to about 30 acres. The native vegetation has thus, on the whole, been little interfered with; and in order to consider it from the ecological point of view, it may advantageously be divided into the following main groups or types of vegetation—a method of classification into which it very naturally falls:—

1. Seashore.
2. Moor and hill-pasture.
3. Meadows and arable land.
4. Woods and plantations.
5. Fresh water.
6. Marine.

1. *Seashore.*

Beginning our observations near the mouth of Loch Striven, and walking up the loch to the northern boundary of the estate, we notice that the shore consists of stretches of shingle interrupted here and there by rocks projecting into the sea, and by flat stretches of salt-marsh. The character of the shore therefore causes the occurrence of three distinct associations of plants, overlapping in the case of some individual species, but in the aggregate quite distinct from one another. These associations fall naturally under the headings of (1) Shingle, (2) Rocks, (3) Salt-marshes.

1. SHINGLE.—Along the upper edge of the shingle, just above high-water mark, an almost unbroken fringe of characteristic plants continues from one end of our area of observation to the other. This association is composed of *Matricaria inodora*, Linn.¹; *Atriplex patula*, Linn.; *Rumex crispus*, Linn.; *Galium Aparine*, Linn.; *Potentilla anserina*, Linn.; *Stellaria media*, Vill.; *Tussilago Farfura*, Linn.; *Sonchus arvensis*, Linn. As one advances further up the loch, the exposure to wind becomes less, and the water of the loch presumably less salt than in the more open parts of the sea. A corresponding change in the vegetation occurs: *Silene maritima*, With., and *Arrhena-*

¹ The species are enumerated in approximate order of frequency.

therum avenaceum, Beauv., at first included among the commonest shingle-plants, have now fallen out; while *Scutellaria galericulata*, Linn., and, finally, *Rumex Acetosella*, Linn., become very frequent. *Rumex crispus*, Linn., and *Matricaria inodora*, Linn., are now seen venturing to situations below high-water mark, while several species characteristic of the woods and pastures which slope down to the lochside, frequently encroach on the domain of the shore plants, and obtain a footing in the shingle. These invading plants include: *Polygonum Hydropiper*, Linn.; *P. Persicaria*, Linn.; *Senecio Jacobaea*, Linn.; *Cnicus arvensis*, Hoffm.; *Cn. lanceolatus*, Hoffm.; and occasionally *Rumex Acetosa*, Linn.; *R. obtusifolius*, Linn.; *Plantago lanceolata*, Linn.; *P. major*, Linn.; *Urtica dioica*, Linn.; *Lychnis Flos-cuculi*, Linn.; *L. dioica*, Linn.; *Scrophularia nodosa*, Linn.; *Sonchus oleraceus*, Linn.; *Galeopsis Tetrahit*, Linn.; *Lythrum Salicaria*, Linn.; *Polygonum Aviculare*, Linn.; and *Circaea lutetiana*, Linn. In addition, *Cardamine hirsuta*, Linn., and *Montia fontana*, Linn., are found in places where the shingle is wet with outflowing little burns, or with moisture dripping down from the banks. In such situations *Iris Pseudacorus*, Linn., also comes down to the shingle's edge.

In many places *Rubus fruticosus*, Linn., *Salix aurita*, Linn., and *Alnus glutinosa*, Gaertn., come down to the very edge of the turf, while, in the northern half of the shore under review, the bordering vegetation is that of the moors, and includes *Euphrasia officinalis*, Linn.; *Potentilla Tormentilla*, Scop.; *Calluna vulgaris*, Salisb.; *Erica cinerea*, Linn.; *E. Tetralix*, Linn.; *Myrica Gale*, Linn.; and *Molinia coerulea*, Moench.

Towards the northern extremity the "shingle fringe" becomes scanty, and some of the typical plants disappear or become less frequent. *Potentilla anserina*, Linn., and *Rumex Acetosella*, Linn., predominate here. Here also the turf frequently forms an abrupt edge where it gives place to shingle, and the narrower strip of shore, with a less abundant and typical seaside vegetation, gives an appearance approaching somewhat to that of a freshwater loch.

2. Rocks.—The fringe of shingle plants, to which the foregoing description has chiefly referred, is interrupted

here and there by rocky portions of the shore where a different set of plants is in occupation. Here we find the furthest outposts of terrestrial vegetation in the form of lichens and mosses—the flat crustaceous forms of the lichens and little round cushions of *Grimmia maritima*, Turn., occupying the otherwise untenanted rocks projecting into the sea, free from competitors in their inhospitable and uncoveted habitat.

Occupying less advanced situations, and forming the typical rock association, are found *Glaux maritima*, Linn.; *Armeria maritima*, Willd.; *Sagina procumbens*, Linn.; *Cochlearia officinalis*, Linn.; *Plantago maritima*, Linn.; and *Atriplex patula*, Linn.

In many places the rocks are crowned with *Ulex europaeus*, Linn.; while *Sedum anglicum*, Huds., is usually found near the edge of the turf. Among the rocks which are furthest up the loch *Festuca ovina*, Linn., occupies advanced positions towards the sea, and here also *Nardus stricta*, Linn., must be included among the rock plants.

3. SALT-MARSHES.—Here and there among the rocks or coarse shingle are found small patches of the salt-marsh type of vegetation composed of *Glaux maritima*, Linn.; *Juncus Gerardi*, Loisel.; *J. articulatus*, Linn.; *Agrostis alba*, Linn.; *Armeria maritima*, Willd.; *Atriplex patula*, Linn.; and *Sagina procumbens*, Linn.

These patches of salt-marsh plants are frequently below high-water mark, which is indicated by a line of loose sea-washed algae and other drift. *Armeria* and *Glaux* indeed are occasionally found further towards the sea than the highest attached algae.

On the north side of the mouth of the Inverchaolain Burn a flat alluvial point is covered with a salt-marsh formation consisting of short turf mixed with *Armeria maritima*, Willd., and *Spergularia media*, Pers.

TOWARD POINT.—This portion of the shore, separated from that which has already been described by an intervening coast-line of 3 or 4 miles' length, deserves to be treated separately on account of differences in the geological formation, and because of the appearance of several species which are not found on the lochside. The sea

here is more open, and the Point is exposed to the full force of southerly and south-westerly gales, which sweep up the Firth of Clyde.

The same three associations are found as before.

1. SHINGLE.—Beginning at the signal station, or westerly point of this portion of our coast-line, we find that the familiar and characteristic “shingle fringe” still continues, containing in great abundance *Atriplex patula*, Linn.; *Matricaria inodora*, Linn.; *Potentilla anserina*, Linn.; *Rumex crispus*, Linn.; *Galium Aparine*, Linn.; *Stellaria media*, Vill.; but to these are now added *Raphanus maritimus*, Sm.; *Agropyrum repens*, Beauv.; *Arenaria peploides*, Linn.; the latter suiting itself equally well to the conditions of shingle or salt-marsh, as indeed does also *Atriplex*. Less frequent and typical are *Polygonum Aviculare*, Linn.; *P. Persicaria*, Linn.; and *Rumex obtusifolius*, Linn.; while, in addition, on the upper edge of the shingle, there also now appear *Artemisia vulgaris*, Linn.; *Polygonum Convolvulus*, Linn.; and *Convolvulus arvensis*, Linn.

Between the signal station and the lighthouse these shingle plants are bordered on the upper side by a rank meadow vegetation in which *Centaurea nigra*, Linn.; *Heracleum Sphondylium*, Linn.; *Daucus Carota*, Linn.; *Arrhenatherum avenaceum*, Beauv.; *Geranium pratense*, Linn.; and *Plantago lanceolata*, Linn., are conspicuously plentiful.

After rounding the Point, and continuing towards the Innellan boundary, we find, in addition to the common plants already mentioned, *Tussilago Farfara*, Linn.; *Rumex Acetosa*, Linn.; *R. Acetosella*, Linn.; *Sonchus oleraceus*, Linn.; and *Silene maritima*, With.

BORDERING PLANTS.—At the top edge of the shingle, usually on the border line of inland vegetation, occur quantities of *Agropyrum repens*, Beauv. The chief bordering formation is a coarse meadow herbage, amongst which the following species (peculiar in this neighbourhood to such localities) are to be noticed: *Geranium pratense*, Linn.; *Ononis spinosa*, Linn.; and *Linaria vulgaris*, Mill. Among the bordering plants are also found *Ulex europaeus*, Linn.; *Rubus fruticosus*, Linn.;

Equisetum arvense, Linn.; and *Arrhenatherum avenaceum*, Beauv.

2. ROCKS.—The rocks at the Point consist chiefly of basalt dykes and schistose limestone, together with boulders and loose pieces of stone too coarse to be included under the term “shingle.” Here are to be found such succulent petrophytes as *Suaeda maritima*, Dumort.; *Spergularia media*, Pers.; in addition to the commoner *Cochlearia officinalis*, Linn.; *Plantago maritima*, Linn.; and *Sedum anglicum*, Huds.

At the lighthouse the coast-line bends sharply towards the north, and the rocks above mentioned give way to Old Red Sandstone conglomerates which persist with occasional intrusive dykes, and interrupting stretches of shingle, as far as the Toward and Innellan boundary. Here, as on the lochside, one finds *Sagina procumbens*, Linn., and *Festuca ovina*, Linn., associated with the rock plants. Where the rocks extend back inland without intervening shingle, a short close turf forms the bordering vegetation containing: *Lotus corniculatus*, Linn.; *Thymus Serpyllum*, Linn.; and *Galium verum*, Linn.

3. SALT-MARSHES.—Along this part of the coast, where the Red Sandstone occurs, the salt-marsh formation is frequently seen in the form of little round tussocks, isolated or in groups. The occurrence, in addition, of considerable stretches of the same formation, suggests the gradual extension of colonies of plants which first obtained a hold as isolated individuals. The formation contains the same plants as the salt-marshes of the lochside: i.e. *Glaux maritima*, Linn.; *Juncus articulatus*, Linn.; *J. Gerardi*, Loisel.; *Armeria maritima*, Willd.; and *Agrostis alba*, Linn.; but in addition to these, quantities of *Aster Tripolium*, Linn.; *Triglochin maritimum*, Linn.; and *Glyceria maritima*, Wahlb., are also found.

Glyceria maritima occurs in large patches at the Point, and frequently extends below high-water mark mixed with detached pieces of sea-weed. *Arenaria peploides*, Linn., is often seen in great mats by itself, as well as being associated with the marsh or shingle plants.

ADAPTATIONS.—Among the species which have been enumerated, numerous examples are to be found of the

adaptations to be met with among plants of dry areas generally, no matter whether these are regions of:—

- (1) Deficient rainfall.
- (2) A substratum unretentive of moisture, such as rocks or sand or shingle.
- (3) Extreme exposure to sun and wind.
- (4) Saline soils inhibiting absorption.

Water Storage.—Succulent plants which store their water-supply in thick fleshy leaves, and sometimes also in a fleshy stem, are well represented by *Suaeda maritima*, Dumort.; *Spergularia media*, Pers.; *Glaux maritima*, Linn.; *Sedum anglicum*, Huds.; *Cochlearia officinalis*, Linn.; *Atriplex patula*, Linn.; and *Aster Tripolium*, Linn.

Reduction of transpiration surface is seen in the narrow linear leaves of *Armeria maritima*, Willd.; *Sagina procumbens*, Linn.; *Triglochin maritimum*, Linn.; and *Plantago maritima*, Linn.; and in the setaceous leaves of *Festuca ovina*, Linn.; and *Nardus stricta*, Linn. The bi-pinnatifid leaves of *Matricaria inodora*, Linn., have segments which are so much reduced that the entire surface is not of great extent; while the small ovoid leaves of *Sedum anglicum*, Huds., and the cylindrical ones of *Suaeda maritima*, Dumort., and *Spergularia media*, Pers., exhibit the minimum surface area compatible with their increased water-storing capacity.

Protection of transpiration surface is instanced in the dense woolly covering to the under surface of the leaves of *Tussilago Furfara*, Linn., and *Artemisia vulgaris*, Linn.; as well as by the silky hairs on those of *Potentilla anserina*, Linn.; and in the more general hairy covering of *Scutellaria galericulata*, Linn. The device of inrolling of leaf-blades is found in *Glyceria maritima*, Wahlb.

Compact or Creeping Habit.—Many of the plants named are of those types which avoid undue exposure to the drying and destructive action of the wind by means of their habit of growth. *Stellaria media*, Vill., and *Galium Aparine*, Linn., for instance, creep close to the surface, availing themselves of what little shelter is afforded by the association of which they form a part. *Sagina procumbens*, Linn., clings close to the rocks, while the cushion-growths of *Armeria maritima*, Willd., and *Grimmia*

maritima, Turn., enable the closely packed leaves to shelter one another.

Stolons and Creeping Rootstocks.—The method of propagation by means of a stoloniferous mode of growth, which possesses such obvious advantages for plants growing in dry areas, is also found among the species of these maritime associations. New plants of *Potentilla anserina*, Linn., can be seen originating by means of widely spreading stolons, through which they are also partially supported by the parent plant until their own roots strike deep enough to obtain nourishment. Thus a plant when once established can rapidly increase into a colony without the risk of new individuals passing through the seedling stage.

Extension of Root System.—Instances also occur of another character frequent among xerophytes: that of a well-developed root-system which strikes down into the moister layers below the shingle, or penetrates the crevices of the rocks. This type is exemplified in *Galium Aparine*, Linn.; *Rumex crispus*, Linn.; *Sonchus*: *Matricaria inodora*, Linn.; *Plantago maritima*, Linn.; *Spergularia media*, Pers.; *Suaeda maritima*, Dumort.

2. Moor.

By far the greatest portion of the area is included in this section, and from lochside to hilltops extends the moorland vegetation, giving to the landscape much of its distinctive colouring—as beautiful in its collective distant effects of purple, green, and brown, as it is in the grace of its individual plants which grow from year to year undisturbed and untrodden on, save by the shepherd and the sportsman, uninterfered with except by the heather-burners and the close-cropping sheep. Here, then, is a considerable tract of land where the most typical of the Highland floras can be studied, ranging from the shores of the loch to a height of 2000 feet, and including the associations of the bog and the hill-pasture, as well as those of the more typically moorland plants.

Bog.—Along the lochside there extends a narrow strip of flattish ground, rising on its inland side into a steep bank, and forming one of the old sea-beaches. Here are

boggy situations, where the predominating plants are *Myrica Gale*, Linn.; *Juncus effusus*, Linn.; *J. articulatus*, Linn.; *Molinia coerulea*, Moench; *Narthecium ossifragum*, Huds.; *Scabiosa Succisa*, Linn.; *Parnassia palustris*, Linn.; and *Orchis maculata*, Linn.

HILL-PASTURE.—Further up, on the drier slopes of the hillsides, are pastures composed chiefly of *Potentilla Tormentilla*, Scop.; *Euphrasia officinalis*, Linn.; *Galium saxatile*, Linn.; *Agrostis vulgaris*, With.; *Festuca ovina*, Linn.; *Linum catharticum*, Linn.; *Thymus Serpyllum*, Linn.; *Trifolium repens*, Linn.; and *Viola palustris*, Linn.; while *Carum verticillatum*, Koch; *Campanula rotundifolia*, Linn.; *Polygala vulgaris*, Linn.; and *Hieracium* species, are also common plants.

DRY MOOR.—The hill-pasture merges, on the one hand, into dry heather moor, where the same plants are associated with *Calluna vulgaris*, Salisb.; *Erica cinerea*, Linn.; *Triodia decumbens*, Beauv.; *Nardus stricta*, Linn.; *Deschampsia flexuosa*, Trin.; *Festuca ovina*, Linn.; and mosses, including *Polytrichum*, *Amblystegium*, and *Hypnum* species, while, on the other, it gives way to extensive tracts of *Pteridium aquilinum*, Kuhn, which overtops and frequently kills out the more low-growing plants. *Pteridium aquilinum* is said now to occupy larger areas of the moor than it did in the memory of those still living, its extension being attributed to the combined effects of the burning of the heather and the replacing of cattle by sheep-stock on the hills. It seldom reaches a higher altitude than 800 or 900 feet, and diminishes in size and frequency as the higher elevations are reached.

Two other ferns are seldom absent from the moorland associations—*Nephrodium Oreopteris*, Desv., and *Lomaria Spicant*, Desv., the latter being found in every nook and cranny but never in large masses.

In places where moor and hill-pasture extend to within a few hundred yards of the shore, clumps of *Ulex europaeus*, Linn., are interspersed.

Less characteristic of the moor, but still very frequent, are *Prunella vulgaris*, Linn.; *Bellis perennis*, Linn.; *Lotus corniculatus*, Linn.; *Plantago lanceolata*, Linn.; *Holcus lanatus*, Linn.; *Anthoxanthum odoratum*, Linn.;

and *Cynosurus cristatus*, Linn.; all of which are represented by small and stunted forms compared to those of richer soils and more sheltered situations.

Among plants of more occasional occurrence may be mentioned *Solidago Virgaurea*, Linn.; *Hypericum pulchrum*, Linn.; *Cerastium triviale*, Linn.; *Oniscus arvensis*, Hoffm.; *Cn. palustris*, Hoffm., and *Cn. lanceolatus*, Hoffm.

WET MOOR.—In damper places *Calluna* is absent, and an association is found comprising *Erica Tetralix*, Linn.; *Molinia coerulea*, Moench; *Juncus effusus*, Linn.; *J. articulatus*, Linn.; *J. squarrosus*, Linn.; *Scabiosa Succisa*, Linn.; *Ranunculus Flammula*, Linn.; *Pedicularis palustris*, Linn.; *Viola palustris*, Linn.; and *Carum verticillatum*, Koch.

Where damp moor merges into actual bog *Sphagnum* is abundant, and is usually associated with *Drosera rotundifolia*, Linn.; *Pinguicula vulgaris*, Linn.; *Narthecium ossifragum*, Huds.; *Parnassia palustris*, Linn.; and *Carex* species.

In peat bogs *Eriophorum polystachion*, Linn.; and *Carices* are commonly predominant.

WATER-COURSES.—The hillsides are everywhere furrowed by burns and little rills, the sides of which are almost invariably decked with yellow clusters of *Saxifraga aizoides*, Linn., while deeper gullies afford shelter for stunted forms of *Betula alba*, Linn.; *Pyrus Aucuparia*, Gaertn.; *Corylus Avellana*, Linn.; and *Salix aurita*, Linn.; accompanied by *Vaccinium Myrtillus*, Linn.; *Teucrium Scorodonia*, Linn.; and *Alchemilla vulgaris*, Linn.

GREEN MOOR.—Although large portions of the moorland vegetation derive their distinctive character from the dominance of *Calluna vulgaris*, Salisb., there is, nevertheless, a considerable extent of ground where this plant is present only in small quantities or else is entirely absent. Here coarse moorland grasses, rushes, and sedges abound, interspersed with the softer herbage of the hill-pastures.

HILLTOPS.—Such an association as that just alluded to is found on the higher slopes of the hills forming the watershed of the Inverchaolain Glen. Along the top of the ridge, on the eastern side, where the elevation is from 1500 to 1700 feet, the heather, where it does exist, is short

and stunted, and is overtopped by *Nardus stricta*, Linn.; *Deschampsia flexuosa*, Trin.; *Juncus squarrosus*, Linn.; and *Scirpus caespitosus*, Linn. To such an extent, indeed, do these four species prevail, that the dun colour of the inflorescences and withered leaves of the grasses, combined with the deeper and more yellow tint of the tops of the rushes, gives to the hill that distinctive colouring which has earned for it the name of "Blair Buidhe," or the "yellow moor."

On Stronyaraig ridge, and on Leacann nan Gall, where the elevation is from 1700 to 1900 feet, the vegetation consists chiefly of the following species: *Empetrum nigrum*, Linn.; *Vaccinium Myrtillus*, Linn.; *V. Vitis-Idaea*, Linn.; *Juncus squarrosus*, Linn.; *Festuca ovina*, Linn.; *Agrostis canina*, Linn.; *Deschampsia flexuosa*, Trin.; *Nardus stricta*, Linn.; *Eriophorum vaginatum*, Linn.; *Galium saxatile*, Linn.; *Potentilla Tormentilla*, Scop.; *Sphagnum*, and *Polytrichum*. In dry, stony situations grey lichens and soft hoary tufts of *Rhacomitrium* are the principal occupants.

Only when one reaches the stony top of Cruach nan Capull, which attains its highest point at an altitude of 2005 feet, are any distinctively alpine plants to be found. Here, in the coldest and most wind-swept situation, creeping low among the stones, are found, among a sparse and stunted vegetation, *Lycopodium Selago*, Linn.; *L. alpinum*, Linn.; and *Salix herbacea*, Linn.

ADAPTATIONS.—The plants which have been enumerated present some typical examples of the modifications to be met with in the floras of regions of physiological drought. The general prevalence of the ericoid habit, seen in the shrubby form and small inrolled leaves of *Calluna*, *Erica*, and *Empetrum*, and in the mycorrhiza of *Calluna* and *Orchis*, is perhaps the most salient character. The conditions as regards exposure closely resemble those of the shore, but the presence of abundant soil-moisture is in striking contrast, while in the check to absorption imposed by the acid humus and want of aeration of the peaty soil there is again an approach to the condition of the salt-marshes. Corresponding with these resemblances and differences in environmental conditions, similarities and contrasts may be

observed in the floras of the two situations. Some few plants, such as *Festuca ovina* and *Nardus stricta*, with their wiry setaceous leaves, are common to both, while on the moors *Nardus* has an additional protective character in its roughness which renders it distasteful to sheep. Linear leaves are represented on the moor by forms like *Carex*, but succulent and woolly types are practically absent. Peculiar to the moor is the insectivorous type represented by *Drosera* and *Pinguicula*.

The moorland plants generally are low-growing and small-leaved. Some ubiquitous forms, such as *Potentilla Tormentilla*, Scop.; *Euphrasia officinalis*, Linn.; *Trifolium repens*, Linn.; and *Plantago lanceolata*, Linn., which in lowland situations are often found growing tall among the meadow grasses, are here small and stunted, flowering low down in the short turf. *Ulex europaeus*, Linn., largest among moorland plants, has disproportionately small leaves; while those of *Vaccinium Vitis-Idaea*, Linn., which are larger than most, are of the leathery type, which like those of smaller size, reduce transpiration to the utmost extent.

On the most exposed situations a creeping habit is adopted, as in the case of *Empetrum nigrum*, Linn.; *Vaccinium Vitis-Idaea*, Linn.; *Lycopodium alpinum*, Linn. The general tendency to reduction in size and in height is well illustrated in the dwarf form of *Salix herbacea*, Linn. This little plant, whose creeping stem may be trodden on unobserved on the barren hilltops, is interesting as the mountain representative of a genus, the commonest species of which are the tall White Willow of the sheltered water-courses, and *Salix Caprea*, Linn., and *S. aurita*, Linn., of intermediate situations.

It is to be noted that all of the species enumerated as forming the typical vegetation of elevations above 1500 feet, are perennials, a condition of things correlated with a short growing season, and common at high altitudes.

3. Meadows, Pastures, and Arable Land.

ARABLE LAND.—The acreage under cultivation is not of great extent, and consists of low-lying and gently sloping fields at Toward Point and at the southern extremity of the main area. Much even of this ground has not been

continuously cultivated, while at Inverchaolain fields formerly under plough are now in pasture.

The crops produced are roots, oats, potatoes and hay. No wheat is grown. Three weeds, *Spergula arvensis*, Linn.; *Polygonum Persicaria*, Linn.; and *P. aviculare*, Linn., appear everywhere in the ploughed land in such prodigious quantities as to vie with the crop, almost obscuring in the height of summer, with a lacy film of linear leaves and pink and white blossoms, the crop plants which have not yet had time to gain the ascendancy by virtue of their taller or more leafy growth.

Other weeds which are common, but never present in such formidable abundance, are *Cerastium triviale*, Link; *Stellaria media*, Vill.; *Potentilla Anserina*, Linn.; *Gnaphalium uliginosum*, Linn.; *Achillea Ptarmica*, Linn.; and *Galeopsis Tetrahit*, Linn.

PASTURES.—As the agriculture of the district consists chiefly in dairy-farming and sheep-grazing, the bulk of the farm lands are in either permanent or temporary pasture. These pastures form a fairly constant type of vegetation, merging on the upper sides of the fields into that of the unenclosed hill-pastures, and on the lower sides into that of the meadows. Here the most frequently occurring plants are *Holcus lanatus*, Linn.; *Agrostis vulgaris*, With.; *Cynosurus cristatus*, Linn.; *Anthoxanthum odoratum*, Linn.; *Euphrasia officinalis*, Linn.; *Potentilla Tormentilla*, Scop.; *Trifolium repens*, Linn.; *T. pratense*, Linn.; *Ranunculus repens*, Linn.; *Prunella vulgaris*, Linn.; *Galium saxatile*, Linn.; *Bellis perennis*, Linn.; *Conopodium denudatum*, Koch; *Plantago lanceolata*, Linn.; *Cerastium triviale*, Link; and *Hieracium* species.

Scattered plants of *Senecio Jacobaea*, Linn.; *Cnicus arvensis*, Hoffm.; *Cn. palustris*, Hoffm.; and *Cn. lanceolatus*, Hoffm., are widely distributed, while in damp and ill-drained situations *Juncus effusus*, Linn., becomes dominant.

MEADOWS AND WASTE PLACES.—In low-lying and damp situations many of the pasture plants still persist, but a number of others, peculiar to such situations, now appear, giving a special character to the meadow lands. Giving

rise to this type of vegetation, besides the enclosed ground where meadow-hay is raised, is a strip of waste land bordering the sides of the road which follows the coast all along the western side of the estate. For the first mile or so, as one proceeds from the southern extremity northwards, this tract is occupied by a rich flora, merging, on the one hand, into that of the shore, and, on the other, into that of the bordering associations of woodland and pasture. Further up the loch many of the meadow plants give way to those of the bog and moorland associations which there extend down to the roadside and the shore. Among the commonest of these meadow plants are:—*Centaurea nigra*, Linn.; *Rhinanthus Crista-galli*, Linn.; *Achillea Millefolium*, Linn.; *Heracleum Sphondylium*, Linn.; *Senecio Jacobaea*, Linn.; *Arrhenatherum avenaceum*, Beauv.; *Holcus lanatus*, Linn.; *Dactylis glomerata*, Linn.; *Agrostis vulgaris*, With.; *Trifolium repens*, Linn.; *T. pratense*, Linn.; *Carum verticillatum*, Koch; *Prunella vulgaris*, Linn.; *Vicia Cracca*, Linn.; *Lathyrus pratensis*, Linn.; *Stellaria graminea*, Linn.; *Rumex Acetosus*, Linn.; *Euphrasia officinalis*, Linn.; *Potentilla Tormentilla*, Scop.; *Lotus uliginosus*, Schk.; *Campanula rotundifolia*, Linn.; *Deschampsia caespitosa*, Beauv.; *Cnicus arvensis*, Hoffm.; *Cn. palustris*, Hoffm.; and *Cn. lanceolatus*, Hoffm.

In the wetter places, often where little burns run out, there occurs abundance of *Spiraea Ulmaria*, Linn.; *Iris Pseudacorus*, Linn.; *Apium graveolens*, Linn.; *Stachys palustris*, Linn.; and *Phalaris arundinacea*, Linn.

As on the moor, *Juncus effusus*, Linn.; *J. articulatus*, Linn.; and *Molina coerulea*, Moench, are dominant in marshy situations; and common in the roadside ditches are *Ranunculus Flammula*, Linn.; *Orchis maculata*, Linn.; *Galium palustre*, Linn.; and *Scabiosa Succisa*, Linn.

Here and there occur clumps of *Rubus fruticosus*, Linn.; *Rosa canina*, Linn.; *Salix aurita*, Linn.; *S. Caprea*, Linn.; while in drier places, usually where there is a rocky substratum, the meadow vegetation is interrupted by *Ulex europaeus*, Linn.; *Sedum anglicum*, Huds.; *Thymus Serpyllum*, Linn.; and *Lotus corniculatus*, Linn.

In the meadow-hay land about the policies *Chrysanthemum*

mum Leucanthemum, Linn., and *Conopodium denudatum*, Koch, together with a larger proportion of grasses, take the place of some of the coarser plants of the lochside.

The same associations are characteristic of the low-lying fields and waste places at Toward Point, the chief difference being in the addition of such plants as *Daucus Carota*, Linn.; *Geranium pratense*, Linn.; *Ononis spinosa*, Linn., already mentioned as bordering on the shore vegetation.

ADAPTATIONS.—Concerning the adaptations to environment among the plants of the meadows and pastures, there is less that calls for remark than among the maritime and mountain species. The localities reviewed are typical of those in which extremes are absent, both as regards exposure and available moisture, and they are generally favourably situated as regards quality of soil. Among the plants named, therefore, a large proportion are representative of the group of Mesophytes or ecologically unspecialised forms, showing no marked reduction or development of stem and leaf, and without any special adaptations to fit them for the conditions of their situation. The majority of them are herbaceous perennials, persisting by underground parts during the winter, more or less broad-leaved during the period of vegetative growth. Annuals, such as *Spergula*, *Polygonum Persicaria*, *Stellaria*, *Gnaphalium*, and *Galeopsis* predominate in cultivated ground, but are poorly represented in the closed vegetation of the meadows and pastures, the two hemi-parasites, *Rhinanthus* and *Euphrasia*, together with *Cerastium triviale*, Link, being the only common annual species which, along with the biennials, *Cnicus palustris*, Hoffm., and *Cn. lanceolatus*, Hoffm., maintain an assured position among the perennial plants. The drawbacks to the annual and biennial habit are largely compensated for in such plants as *Spergula*, and the two above-mentioned species of *Cnicus*, by their adaptations for wind-distribution by means of winged seed or pappus calyx. This advantage is, however, also shared by perennials, such as *Hieracium Pilosella*, Linn., and *Salix* with its arillar hairs. The wide dispersal and usually scattered positions of these wind-distributed plants are in marked contrast to the densely clustered colonies of species with creeping rootstocks, such as *Iris* and *Juncus*.

4. Woods.

EXTENT AND DISTRIBUTION.—The area under woods, both natural and planted, consists of about 300 acres situated chiefly along the shores of the loch, in the lower part of the Inverchaolain Glen, and on the west side of Glen Fyne. It comprises various detached blocks and strips, as well as ornamental grounds, and, with the exception of one young plantation in a sheltered corrie, the woods nowhere reach an altitude of more than about 500 feet. At Toward Point the land under trees is an escarpment known as "Toward Bank," and a few acres of plantation.

NATURAL WOODS—The natural woods of Finart and Brackley are composed chiefly of birch, hazel, rowan, oak and ash, with an occasional intermixture of gean, alder, and elm. These woods straggle up the hillsides with picturesque broken outlines, assimilating with the landscape and contrasting sharply with the angular and rigid forms of the enclosed plantations. None of the trees attain to any great size, and none of the species are deep shade-bearers; in addition, the woods have been much thinned, and thus the shade is nowhere deep. Except for an acre or two, enclosed to create cover for game, they are open to the hill sheep, and the ground vegetation, which is close-cropped, differs little from that of the hill-pastures and moorland bogs into which the woods gradually merge without any distinct boundary line. In the enclosure in Finart Wood just referred to, the natural undergrowth has come up, and consists of the same species as the woodland vegetations about to be described.

PLANTATIONS.—These consist chiefly of:—

- (1) Mixed broad-leaved and coniferous trees.
- (2) Pure coniferous
- (3) Ornamental grounds.

(1) The mixed woods, which constitute the bulk of the planted area, contain such trees as larch, Scots pine spruce, ash, sycamore, and oak; and since they are not close-planted, a considerable amount of undergrowth finds sufficient light and air to grow up. This includes *Rubus fruticosus*, Linn.; *Rosa canina*, Linn.; *Corylus Avellana*, Linn.; *Lonicera Periclymenum*, Linn.; and *Prunus spinosa*, Linn.

In shady places where the soil is deep and not too dry, one finds abundance of *Mercurialis perennis*, Linn.; *Scilla nutans*, Sm.; and *Lychnis dioica*, Linn.

In poorer soils *Luzula sylvatica*, Gaud., is all-pervading, while *Nephradium Filix-mas*, Rich., *N. dilatatum*, Desv., and *Athyrium Filix-foemina*, Bernh., are scarcely ever absent from any part of the woods. Other common plants are *Oxalis Acetosella*, Linn.; *Prunella vulgaris*, Linn.; *Ajuga reptans*, Linn.; *Pteridium aquilinum*, Kuhn; *Epilobium montanum*, Linn.; and *Ranunculus acris*, Linn.

Somewhat less abundant and more partial in distribution are *Primula vulgaris*, Huds.; *Geranium Robertianum*, Linn.; *Circaea lutetiana*, Linn.; *Scrophularia nodosa*, Linn.; *Brachypodium sylvaticum*, R. et S.; and *Digitalis purpurea*, Linn., the last species often appearing in great quantities where woods are cleared. *Iris Pseudacorus*, Linn., is plentiful in marshy places near sea-level.

In young plantations, where the trees are not of sufficient size to shade the ground, moorland or meadow plants, according to situation, being freed from the depredations of sheep and rabbits, grow with great luxuriance. As the shade increases, however, most of them gradually die out, and are superseded by typical woodland plants, although some few species, common to both habitats, remain.

(2) In those portions of the plantations which consist of larch and spruce only, or of pure Scots pine, the denser shade and the thick carpet of coniferous leaves are unfavourable to undergrowth. The occurrence of an open vegetation has thus been induced, consisting of a definite but limited association of plants. These are *Oxalis Acetosella*, Linn.; *Galium saxatile*, Linn.; *Nephradium Filix-mas*, Rich.; *N. dilatatum*, Desv.; *Athyrium Filix-foemina*, Bernh.; and mosses, including *Mnium hornum*, Linn.; *Catharinia undulata*, Web. et Mohr; *Plagiothecium undulatum*, B. et S.; and *Hypnum species*.

(3) The ornamental grounds, which extend along the right bank of the Ardyne Burn for a part of its course, contain a mixture of introduced and native trees, such as beech, sycamore, lime, silver fir, larch, spruce, ash, holly, Scots pine, and rowan. The introduced *Rhododendron*

ponticum, Linn., grows everywhere with great vigour, and seeds abundantly, competing successfully against the sturdiest of native plants.

Under the shade of these trees, and on the steep rocky banks which form the bed of the Ardyne Burn, are to be found some characteristic woodland associations of three or four different types, but all merging imperceptibly into one another. These may be roughly summarised under the following heads:—

1. Cryptogamic Association.
2. *Mercurialis* dominant.
3. *Luzula* dominant.
4. *Vaccinium-Teucrium* Association.

1. *Cryptogamic Association*.—From the rocks in the bed of the burn to the dripping banks and rocky clefts along the sides of its course, there is a series of situations forming a congenial home for the moisture- and shade-loving ferns, mosses, and liverworts. Among the ferns *Nephrodium Filic-mas*, Rich.; *N. dilatatum*, Desv.; and *Athyrium Filix-foemina*, Bernh., are the commonest species, and are distributed in almost all situations. *Polypodium vulgare*, Linn., is common as an epiphyte on tree-trunks; *Asplenium trichomanes*, Linn., is a common occupant of crevices in the rocks, while *Lomaria Spicant*, Desv., is frequent in drier and more open situations.

Among the mosses, where so many are common, it is difficult to single out a few, but three or four species at least cannot fail to be familiar to the wanderer of these woods, even though they be not known to him by name. *Mnium hornum*, Linn., is present under almost every tree, and forms extensive carpets under beech trees, where frequently few or no competitors dispute its entire possession of deeply shaded banks. *Polytrichum commune*, Linn., is conspicuous in its size and frequency, as well as in its tall erect habit. *Thuidium tamariscinum*, B. et S., another common species, is remarkable for the beauty of its fern-like branching form, while thick soft tufts of *Dicranum scoparium*, Hedw., and *D. majus*, Turn., shine out in winter with a rich emerald green, unrivalled in its depth and brilliancy.

The mosses collectively form one of the most characteristic features of these woods. There is scarcely a rock, a tree-trunk, or a stone dyke where some representative of the class is not an occupant, or an association of woodland plants that does not include several. Although not absent from the moor and the shore, or even from the pasture fields, it is in the shade and moisture of the woods that they flourish in greatest numbers both of species and individuals. Luxuriating in the dull damp days of autumn and winter, they show to best advantage while most other plants are undergoing their winter sleep; humble in their positions, and unobtrusive in their growth, they yet give beauty and colour to otherwise lifeless surroundings.

The numbers of archegoniate plants present in these woods is an indication of the constancy of moist conditions. Not all arrive, at the same season of the year, at that stage in their life-history when water is a necessity, and the minimum exposure to drying winds and sun, as well as the conditions of situation favouring the retention of surface moisture, enables that critical stage to be passed through by some or others of the group at almost any time.

The other three associations may be treated collectively. For considerable areas through the wood *Mercurialis perennis*, Linn., and *Luzula sylvatica*, Gaud., are the dominant plants. Sometimes they are found together, but more often one or the other almost monopolises wide tracts. *Mercurialis* is found in the richer and deeper soils, and is often associated with *Scilla nutans*, Sm., and *Allium ursinum*, Linn. *Luzula sylvatica*, Gaud., is a particularly aggressive plant, spreading freely by means of both seed and creeping rootstock. Higher up the glen on drier and poorer soils, and where the ground has been more recently reclaimed from the moor; *Vaccinium Myrtillus*, Linn.; *Teucrium Scorodonia*, Linn.; and *Lomaria Spicant*, Desv., are often found associated.

TOWARD POINT.—At Toward Point two small areas of woodland require special notice because of the difference in soil and situation. These are:—

- (1) A few acres of plantation—thirty to forty years old—in low-lying marshy ground.

- (2) "Toward Bank," or an escarpment of Old Red Sandstone, grown over with trees and thick undergrowth.

In the first of these areas, owing to the marshiness of the situation, a flora has appeared differing from that of the woods already described. The trees here consist chiefly of alder and sycamore, the latter being planted in the drier situations. Under the alders the undergrowth is tall and rank and difficult to penetrate. It consists largely of plants typical of wet meadows, which have been fostered by the shelter of the trees, and protected from interference by barbed wire fencing and an uninviting situation. Among these tall moisture-loving plants are *Festuca elatior*, Linn.; *Deschampsia catespitosa*, Beauv.; *Phalaris arundinacea*, Linn.; *Heracleum Sphondylium*, Linn.; *Apium graveolens*, Linn.; *Angelica sylvestris*, Linn.; *Spiraea Ulmaria*, Linn.; *Iris Pseudacorus*, Linn.; *Galium Aparine*, Linn.; *G. palustre*, Linn.; *Lychnis dioica*, Linn.; and *Urtica dioica* Linn. In less abundance also occur *Valeriana officinalis*, Linn.; *Lythrum Salicaria*, Linn.; and *Equisetum arvense*, Linn.; while semi-aquatics such as *Caltha palustris*, Linn., and *Polygonum Hydropiper*, Linn., are also found.

Among the plants mentioned, *Angelica* and *Apium* reach a height of about 5 feet, obscuring smaller plants by the density and vigour of their growth. In the drier situations under sycamore and ash, the ground vegetation becomes more typically woodland, less rank, and in some places open. Here we find many of the common sylvestral types of flowering plants and ferns which have already been enumerated.

Along the banks of a little burn which here runs down to the sea are to be seen *Salix alba*, Linn., and *Petasites vulgaris*, Desf.—largest-leaved of British plants.

At "Toward Bank," above and below the cliff where the woodland associations merge in those of the meadow, the vegetation is of a coarse, rank kind. Here, characteristic plants are *Centaurea nigra*, Linn.; *Spiraea Ulmaria*, Linn.; *Heracleum Sphondylium*, Linn.; *Apium graveolens*, Linn.; *Rumex obtusifolius*, Linn.; *Cnicus arvensis*, Hoffm.; *Mentha aquatica*, Linn.; *Scabiosa Succisa*, Linn.; *Urtica dioica*, Linn.; *Dactylis glomerata*, Linn.; *Holcus lanatus*, Linn.;

Phragmitis communis, Trin.; *Phalaris arundinacea*, Linn.; *Juncus effusus*, Linn.; and *Iris Pseudacorus*, Linn.

On the bank the predominant trees are sycamore, beech, oak, and ash.

All along the cliff, owing to its height and deep clefts, and the number of shade-bearing trees such as sycamore and beech, the shade is very deep. Here, then, we find again the typical sylvestral species such as *Allium ursinum*, Linn.; *Scilla nutans*, Sm.; *Mercurialis perennis*, Linn.; *Primula vulgaris*, Huds.; *Circaea lutetiana*, Linn.; *Teucrium Scorodonia*, Linn.; *Lychnis dioica*, Linn.; *Geranium Robertianum*, Linn.; *Brachypodium sylvaticum*, R. et. S.; *Arctium Lappa*, Linn.; *Luzula sylvatica*, Gaud.; *Epilobium montanum*, Linn.; *Athyrium Filix-foemina*, Bernh. Less common but not unfrequent are *Asperula odorata*, Linn.; *Lysimachia nemorum*, Linn.; *Hypericum pulchrum*, Linn.; and *H. Androsæmum*, Linn.

Owing to the inaccessibility of the cliff, numbers of these shade-loving plants grow in wild luxuriance, forming with the undershrubs tangled masses of vegetation which still further add to the impregnability of their chosen stronghold. Among the undershrubs are *Corylus Avellana*, Linn.; *Crataegus Oxyacantha*, Linn.; *Rubus fruticosus*, Linn.; *Rosa canina*, Linn.; *Prunus spinosa*, Linn.; *Sambucus nigra*, Linn.; *Pyrus Aucuparia*, Gaertn.; *Lonicera Periclymenum*, Linn.; *Hedera Helix*, Linn.; and *Pteridium aquilinum*, Kuhn. These all assist in rendering the shade of the ground plants denser, and their shelter more complete.

On the rocks, where moisture is plentiful, mosses and liverworts abound, while in drier situations *Polypodium vulgare*, Linn., *Asplenium adiantum nigrum*, Linn., and *Scolopendrium vulgare*, Sm., occupy otherwise bare portions of the rock. At the top of the bank at the north end, where a group of old beeches spread their dense shade, *Mnium hornum*, Linn., alone of the ground plants finds a congenial home, while other species which grow so abundantly in the rest of the wood are absent or stunted.

Considering the woodland plants from the point of view of their adaptations, rather than from that of the associations which they form, one finds that three characteristic types are well represented:—

(1) Early flowering perennials, which by reason of their storage organs in the form of bulbs, tubers, or rhizomes, are able to flower in early spring, and take advantage of a larger share of light before they become shaded by the summer foliage of the trees, are represented by *Ranunculus Ficaria*, Linn.; *Chrysosplenium oppositifolium*, Linn.; and *Mercurialis perennis*, Linn. Of the same type, but flowering when spring is more advanced, are *Scilla nutans*, Sm., and *Allium ursinum*, Linn.

(2) Broad and thin-leaved herbaceous plants, usually with well-developed axis and long internodes, are present in great abundance, indicating plainly by their habit of growth that whatever the difficulties may be with which they have to contend, these at least do not include deficiency of moisture or undue exposure to the blustering winds. Among these plants are such species as *Scrophularia nodosa*, Linn.; *Circuea lutetiana*, Linn.; *Stachys sylvatica*, Linn.; and many others whose names need not be again repeated.

(3) Twining and scrambling forms, less rich in species than the last-named set, but numerous in individual plants, are represented by *Hedera*, *Lonicera*, and *Rubus*.

5. Fresh-Water Aquatics.

The group of fresh-water aquatics is the most poorly represented among the six ecological sections into which the plants of the area have been divided. Not only are sheets of fresh water very few, but where they do exist the number of aquatic species found in them is exceedingly limited. Nevertheless a few typical and contrasting forms are to be seen in the moorland lochan, mountain tarns, and lowland artificial pond which constitute almost the only available habitats for aquatic plants.

Stronyaraig Lochan is a small natural sheet of water situated on the right side of the Inverchaolain Glen, at an elevation of about 400 feet. It is very shallow, and is frequently partially dried up in summer. The surrounding vegetation is that of the Calluna Moor. Here are to be found *Glyceria fluitans*, Br., with long floating leaves, and *Peplis Portula*, Linn., and *Apium inundatum*, Reichb., both submerged. The latter species, with its finely divided

leaves, reduced flowers, weak stem, and superficial chlorophyll-cells, exhibits some of the salient features of aquatic plants. *Littorella lacustris*, Linn., is another plant of the lochan, producing its short, awl-shaped leaves beneath the water, while the wind-pollinated flowers with their long stamens appear when the water recedes in dry summer weather.

On the hilltops small tarns with a peaty substratum are occupied by submerged masses of *Sphagnum cuspidatum*, Ehrh., and *Amblystegium fluitans*, De Not. Another aquatic moss, *Hypnum rusciforme*, Weis., occurs on rocks in running water, while in most pools and ditches, and slowly flowing rills, green algæ are to be found.

The only other situation for fresh-water aquatics is an artificial pond in the policies, constructed to maintain a supply of water for working a sawmill. *Littorella lacustris*, Linn., is again plentiful here, forming a submerged turf around the margin of the pond. Occupying an intermediate position, as regards aquatic habit, between this species and the meadow plants on the banks, is *Caltha palustris*, Linn., growing at the water's edge, or even within it, but with aerial shoots above the surface. Rooted in the mud at the bottom of the pond, with ribbon-leaves floating on the surface, is *Spargunium natans*, Linn., solitary representative in all the countryside of the order to which it belongs, showing in the large air-spaces and mucilaginous character of its leaves other typical hydrophytic features.

6. Marine Vegetation.

Although not exposed to wave action equal to that of the open sea, the shore at the mouth of Loch Striven can nevertheless not be called a sheltered one, and considerable damage has been done to a couple of miles of the coast-line from the mouth of the Loch upwards, during coincident storms and high tides of the winter of 1912-13. Further up the loch the wave action is naturally less, but the steep hills with intersecting glens on both sides of the loch render it subject to sudden squalls. The greatest depth of the loch is 41 fathoms, and the rise of the tide at spring tides is about 10 feet.

The marine algae of this shore are not present in very great variety, but some of the commoner species are very abundant between the tide-marks. Generally they are most plentiful on the rocks, and are more sparsely distributed on the loose stones which take the place of shingle on the lower reaches of the beach.

The highest zone, covered only at high tide, includes *Enteromorpha* and *Pelvetia canaliculata*, Dne., both of which may be observed growing in close contact to terrestrial plants such as *Armeria maritima*, Willd. Next in succession comes *Ascophyllum nodosum*, Le Jol., with *Polysiphonia* epiphytically attached, passing towards low-water mark into *Fucus vesiculosus*, Linn., and *Fucus serratus*, Linn. All these are present in great abundance. No less common are *Cladophora* and *Gigartina* in the rock-pools, accompanied occasionally by *Ulva* in the higher zones, and by *Corallina* in the lower ones, *Cladophora* being specially abundant in the central zone, while *Gigartina* is found throughout the region immediately above low-water mark.

Other algae, such as *Halidrys*, *Ectocarpus*, *Porphyra*, and *Ceramium*, are to be found at low water, but are considerably less abundant than the majority of those already mentioned.

Laminaria digitata, Linn., and *L. saccharina*, Linn., are both found at or near low-water mark. The latter species is specially abundant in the quieter waters up the loch, where at low tide, for considerable distances along the shore, the frilled edges of its long thallus can be seen protruding from the water a few feet from the shore, while its hold-fasts, attached to rocks and stones, remain unexposed.

At Toward Point the same species occur, and they are distributed in the same zones. Here, however, the beach shelves much more gradually, leaving a greater extent of shore exposed at low water. The sea here is more open, and the rocks and boulders are exposed to a considerable amount of wave action. These on the west side are profusely covered by the commoner algae, among which *Ascophyllum* is specially conspicuous in its abundance, favoured by a firm substratum and the gradual slope of the beach which facilitates the retention of moisture

between ebb and flow. Where, however, sandstone rocks occur, they shelf more steeply, and it is noticeable that on them the brown seaweeds are scantily represented, large ledges of the rock remaining quite devoid of vegetation, while those portions which are covered are chiefly occupied in the lower zones by *Gigartina*, and higher up by *Cladophora* and *Enteromorpha*.

One marked difference in the dominance of species distinguishes the distribution of the algae at Toward Point from that in Loch Striven. All round the Point at low spring tides, occupying yards of ground both above and below the water's edge, there becomes exposed what might be taken as the very home of *Laminaria digitata*, Linn. Quantities of its yellow-brown thallus protrude from the shallow sea beyond low-water mark, while innumerable holdfasts and thallus "stalks" are exposed on the damp rocks, standing up like the stumps of some strange marine forest, and suggesting, in the contrast of general habit with that of the algae next above, the possibility of still further variations in growth-form or dominance of species in that unknown world below the waters which even the lowest tides do not reveal.

The three groups of Chlorophyceae, Phaeophyceae, and Rhodophyceae are thus all well represented, the Greens occupying the highest zone and the Reds the lowest, while they overlap to a large extent between the two extremes in the distribution of *Cladophora* and *Gigartina*. The Browns, on the other hand, extend in a series of species across the whole region between the tide marks.

CONCLUDING REMARKS.

The account which has been given does not pretend to be exhaustive. Mention of many less common species has been purposely omitted in order to avoid undue extension of mere lists of plants, and because it is felt that the frequency of a species rather than its rarity is what gives it a claim to the notice of the ecologist. The primary aim has been to describe the grouping of the characteristic plants and the situations which they occupy, while at the same time keeping in view how these, taken as particular



PART OF ARGYLLSHIRE, SHOWING ESTATE OF KNOCKDOW. (Scale 1 inch to 1 mile.)

(Reproduced from the Ordnance Survey Map with the sanction of the Controller of H.M. Stationery Office.)

The dotted line shows the Highland Boundary Fault.



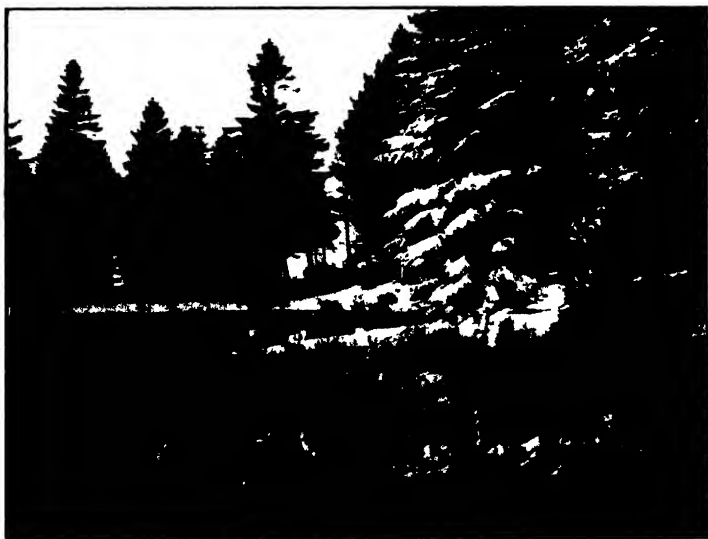
Loch Striven.



Glen Fyne from Goats' Ford Wood.



Goats' Ford Wood.



Sawmill Pond.

instances, illustrate general facts regarding the adaptation of plants to their environment.

The area chosen for review had much to recommend it as a convenient unit. It is, in its chief botanical features, representative of the district of which it forms a part, the commonest species and their associations being equally characteristic of surrounding localities. In addition, it has the advantage of being not too large for easy accessibility and thorough review from a single centre. A special point of interest lies in the inclusion of the two geological systems, which give opportunity for observation that they do not exhibit any correlated contrast in the general character of their respective vegetations, but that nevertheless a few isolated species flourish on the Old Red Sandstone which are either absent or rare on the Metamorphic Highland Rocks. Among these species the most notable instances are *Galium verum*, Linn.; *Ononis spinosa*, Linn.; *Linaria vulgaris*, Mill., found only on the Sandstone, and *Scolopendrium vulgare*, Sm., found off it only as a species of extreme rarity.

The points in which the area falls short of being representative should also be noted. One of these is the scantiness of the alpine flora. Higher hills to the North, and even some which do not exceed Cruach nan Capull in altitude, but have a larger area reaching approximately to the same height, possess a considerably greater variety of alpine plants. Secondly, some species, which are not rare but of partial distribution, have been found in neighbouring localities, but not within the area. Among those are some which are undoubted natives, such as *Hymenophyllum unilaterale*, Willd.; *Antennaria dioica*, Br.; *Gentiana campestris*, Linn.; and *Salicornia herbacea*, Linn.

This, then, concludes a review which has been the result of many lonely rambles both before and during its compilation. It has been the outcome of an appreciation for, and interest in, the wild plants in their native haunts where natural beauty is still unspoiled by the devastating hand of civilisation. It has had its origin in a desire to make an attempt, however imperfect, to attain, by means of original observation, some insight into that great and attractive field of botanical science known as ecology.

NOTE ON RHODODENDRON CYANOCARPUM, FRANCH.

By W. W. SMITH, M.A.

(Read 15th January 1914.)

When the late M. Franchet was engaged in describing the numerous Rhododendrons sent by the French missionaries from Western China—the richest area in Rhododendrons in the world,—among the material sent by the Abbé Delavay were a few fruiting specimens of a Rhododendron which Franchet saw was exceedingly near to the Himalayan *R. Thomsoni*, Hook. f. The leaves and calyx of the Yunnan species seemed at first sight identical with those of the Himalayan one. The calyx of *R. Thomsoni* is very distinct from that of any of the other Himalayan species, and the marked similarity to the calyx of the Yunnan plant led Franchet to consider that when flowers of the latter were obtained, the great probability was that the two plants would belong to the same specific type. However, with great acumen, considering the fragmentary material he had to work upon, he noted certain minor points of difference which were his justification for giving a separate name to the Yunnan plant—*R. Thompsoni*,¹ Hook. f., var. *a cyanocarpum*; the varietal name he qualified by putting “species propria” in brackets after it. The species has remained for many years without further elucidation, and only recently additional material, including flowers, has made it possible to justify Franchet’s opinion and to establish Delavay’s plant as a good species.

In the first place, I quote Franchet’s remarks in full²:—

“*Rhododendron Thompsoni*, Hook. f., *Rhod. Sikk. Him.*, tab. 12, *a cyanocarpum* (species propria). ”

“Frutex in omnibus partibus glaberrimus; folia basi obtusa vel vix distincte subcordata; capsula juvenilis cyanea, matura atrocyanea, pedicellis rigide erectis. Flores ignoti.

“*Hab.*—Yunnan, rochers du Tsang-chan (Delavay, n. 3947, 4166).

“C’est un arbrisseau très tortueux, épais; ses feuilles

¹ Misspelt with a “p” by Franchet.

² “*Journ. de Bot.*,” ix. (1895), 389.

ressemblent beaucoup à celles du *R. Thompsoni*, Hook., mais le plus souvent elles sont seulement obtuses et non échancrées à la base; les bourgeons sont très allongés, aigus, à écailles lâches, fauvepâles, les intérieurs lancéolées, les plus extérieures presque arrondies, ciliolées. Les capsules du *R. Thompsoni* sont penchées et Hooker les dit glauques et pourpres; celles de la variété signalée ici sont d'un bleu foncé à la maturité, glauques, et strictement dressées sur un pédicelle raide. La forme du calice est si semblable et si caractéristique dans les deux plantes que, bien que les fleurs de la variété *cyanocarpum* n'aient pas été encore observées, il y a des probabilités pour qu'elles appartiennent au même type spécifique."

The additional material referred to above consists of three gatherings made by G. Forrest in the Tali Range, Yunnan. These I have compared with Delavay, No. 4166, in the Kew Herbarium, and have no doubt that they are conspecific. In this view I am only following the lead of Professor L. Diels in "Notes Roy. Bot. Gard, Edin.," vii. (1912), 209, where he determines Forrest, No. 4137, as *R. Thomsoni*, Hook. f., var. *cyanocarpum*, Franch., after comparison with the types Delavay, 3947, 4166, at Paris I give below a more detailed description of the species, with a citation of the sheets known to me.

Rhododendron cyanocarpum, Franch. Descript.
emend. et amplif.

Species valde affinis *Rhododendro Thomsoni*, Hook. f., foliis basi vix cordatulis, floribus majoribus albis, pedicellis fructiferis erectis, inter alia signa recedit.

Frutex 1.5-4 m altus; ramuli rigidi, cortice griseo tecti. cicatricibus magnis notati; gemmae anguste ellipticae acutiores squamulis inferioribus fere orbicularibus, superioribus ovatis vel lanceolatis, albo-ciliolatis. Folia 6-11 cm. longa, saepius circ. 10 cm., 4.5-7 cm. lata, saepius 6 cm., late elliptica, apice rotundata breviter apiculata, basi rotundata nec cordatula, utraque facie glabra, supra viridia, infra glauca, venis conspicuis purpureis venulisque bene reticulatis notata; petiolus 2-2.5 cm. longus robustus glaber. Flores 3-7-nati, patentes vel subcernui, fragrantés,

pedicellis 1-1.5 cm. longis glabris, bracteis 1-1.5 cm. longis, linearibus stramineis, \pm albo-patenti-ciliatis. Calyx amplus, ad 1.25 cm. longus, cyathiformis, irregulariter 5-lobus, lobis aliis obscuris aliis ad imum petentibus rotundatis vel obtusis, glaucus, nonnunquam purpurascens, glaber, fructu vix auctus. Corolla 5-6.5 cm. longa, late infundibuliformis, alba vel roseo-alba membranacea vix coriacea; tubus 4-4.5 cm. longus, a basi circ. 1.5 cm. lata (in sicco) ad orem circ. 6 cm. latum (in sicco compressum) amplius; lobi 5, suborbiculares, 2-3 cm. diametro, breviter emarginati, paulo patentes. Stamina 10, inclusa, tubum vix aequantia, filamentis glabris, antheris brunneis. Ovarium conico-cylindraceum sulcatum glabrum. Fructus 1-1.5 cm. longus, calyce persistente, erectus pedicello stricto, eximie cyaneus.

Yunnan.—“Rochers du Tsang-chan.” Delavay, No. 3947, 4166, ex Franchet in “Journ. de Bot.,” ix. (1895), 389.

“In dumetis montis Tsang-chân. Alt. 3000 m. Species rara in unico loco visa; fructus immaturi eximie cyanei. Flores ignoti.” Delavay, No. 4166, in Herb., Kew!

“Shrub of 8-12 feet. Flowers pinkish-white. Open, moist situations on mountain meadows on the eastern flank of the Tali Range. Lat. 25° 40'. Alt. 10,000-11,000 feet. July 1906.” G. Forrest, No. 4137!

“Shrub of 4-9 feet. Flowers rosy-white, fragrant. Moist mountain meadows on the eastern flank of the Tali Range. Lat. 25° 40'. Alt. 12,000 feet. Aug. 1910.” G. Forrest, No. 6775!

“Shrub 4-6 feet. Flowers creamy-white, pale rose exterior. Margins of pine forests on the eastern flank of the Tali Range. Lat. 25° 40'. Alt. 12,000 feet. June 1910.” G. Forrest, No. 6779!

Rhododendron cyanocarpum, Franch., now that it is more adequately known, is seen to be distinguished from the Himalayan *R. Thomsoni*, Hook. f., by the following chief points:—

1. The leaves are larger, more elliptic, and do not appear to have the “squareness” of outline which is so often seen in *R. Thomsoni*; they are much longer than broad; the bases do not show the small cordate notch characteristic of its ally; the veining is much more conspicuous in the

Yunnan plant; the leaf-buds are more pointed and the scales white-ciliolate.

2. The flowers are white or rosy-white, fragrant, and considerably larger than those of *R. Thomsoni*, which have a beautiful deep blood-colour and are inodorous; the consistency of the corolla of *R. cyanocarpum* is much thinner (in the dry state membranous) and very different from the firm, fleshy texture of *R. Thomsoni*.

3. The ripe fruits are erect on a stiff peduncle, while those of *R. Thomsoni* have a distinct downward curve.

AN HIMALAYAN VARIETY OF *PLUMBAGELLA MICRANTHA*,
SPACH. By W. W. SMITH, M.A.

(Read 9th April 1911.)

Plumbagella micrantha, Spach, the only species known of the genus, was first described in 1829 in Ledebour's "Icones Flor. Ross.," p. 7, under the name of *Plumbago micrantha*, Ledeb., and was accompanied by a good figure (tab. 21).

The genus *Plumbago* was afterwards divided by Spach ("Hist. Veg. Phan.," x. (1841), p. 333) into three genera. Of these, *Plumbago* and *Plumbagella* are retained in Engler's Pflanzenfamilien IV., 1, 122, while *Plumbagidium* is taken as a section of *Plumbago*. *Plumbagella* seems distinct enough generically, with its small funnel-shaped corolla and with its calyx much enlarged after flowering. The habit of the plant is also very different from what we find in *Plumbago*.

I quote Spach's pertinent remarks in support of the validity of his genus *Plumbagella*, as the book in which they occur is one not readily accessible. He points out that it differs from *Plumbago* as follows:—

"1. Par un calice profondément 5-fide, écosté, scarieux seulement aux bords des segments à tube finalement garni de 5 crêtes longitudinales, fougueuses, dentées, alternées avec les segments;

"2. Par une corolle à peine plus longue que le calice, tubuleux-cylindracée, très courtement 5-fide;

"3. Par un style court, à peine aussi long que les stigmates.

"Cette species est annuelle (en quoi elle diffère aussi de toutes les autres Plombaginées) à tiges paniculées; ses feuilles sont sinuolées ou denticulées, minces, glabres, sessiles, amplexicaules, cordiformes-bilobées à la base (à oreillettes plus ou moins adnées) couvertes en dessous d'une poussière glauque. Les fleurs sont glomérulées aux aisselles des feuilles supérieures et des bractées."

In Ledebour's description the habitat is given as "Prope pagum Tschetschulicha ad fluvium Tscharysch, unico tantum loco, ubi olim ager Calmuckorum fuisse dicitur"—in the Altai Mountains. The occurrence of the genus in the Himalaya is an interesting extension of the range. Among the specimens collected in the Chumbi Valley in 1912 by Rohmoo Lepcha is a small dwarf representative of the Altai plant which at first sight looks a distinct species. After careful dissection, however, and comparison with the examples of the Altai plant at Kew, I am unable to justify separation specifically, but the Himalayan plant should be distinguished at least by a varietal name.

Plumbagella micrantha, Spach, var. *himalaica*, W. W. Sm. Var. nov.

Varietas nana 5-10 cm. alta, basi ramosa; rami subdecumbentes sparse muriculati; flores subcapitati, bracteis ovatis imbricatis nigrescentibus fere occulti.

Eastern Himalaya.—At Chugya in the Chumbi Valley, alt. 15,000 feet; Rohmoo Lepcha, No. 288 in Herb. Edin. et Herb. Kew. et Herb. Calcutt.

I find no reference to the occurrence of the plant in China, nor do I find any record from Tibet. It is, however, the type of plant which is likely to frequent the Tibetan plateau, and no doubt, when its distribution is more fully known, it will be found that the centre of its habitat is Tibet, and that the Himalayan and Altai records are "outliers" from that.

The tubercles on the fruit suggest to me the mode of dispersal of *Circaeaster agrestis*, Maxim.—the fruits of both species are adapted to cling to the wool of sheep, and I believe that, as in the case of *Circaeaster*, the wandering flocks are the chief factor in the increase of the area of distribution. Neither species appears to be such as would succeed in opposition to the local flora unless aided by some

special circumstance. Just as many species hold their own in temperate regions only through association with cultivated crops, so there are species in alpine and desert areas which depend on such adventitious factors as the occasional visit of a flock of sheep. I am sure that *Circaeaster* follows the shepherd. It is likely, in my opinion, that *Plumbagella* does the same.

In the Central Asiatic Highlands the flocks during the short summer make a long excursion up the valleys into the higher altitudes, advancing by slow stages to a high elevation (even to 15,000-16,000 feet), and returning by similar stages under the pressure of the advancing autumn. These stages are performed by the same flock year after year, and certain definite spots in the long chain are used, generation after generation, as halting-places for a few days. These areas are often clearances in dense jungle such as rhododendron forest, and have sometimes a very characteristic vegetation. The majority of the species are invaders from not distant meadows and slopes, but a few are wanderers who have had a long and precarious "trek" from an entirely different clime—for example, a journey from the exposed and bare Tibetan plateau to the dense forest of a Sikkim valley. *Circaeaster* and *Plumbagella* are wanderers of this type, and should be distinguished from the regular frequenters of the sheep-tracks, such as certain *Polygonaceae* and *Chenopodiaceae* typified by *Polygonum filicaule*, Wall., *Polygonum perpusillum*, Hook. f., *Microgynaecium tibeticum*, Hook. f.—which may be said to compose a definite formation comparable to the *Lägerpflanzen* of the Swiss Alps.

A TUBEROUS *SENECIO* FROM CHINA.

By W. W. SMITH, M.A.

(Read 9th April 1914.)

Senecio tuberivagus, W. W. Sm. Sp. nov.

Species ex affinitate *Senecionis farfaraefolii*, Maxim. et *S. dahurici*, Schultz-Bip.; ob stolones subterraneos praelongos tuberibus terminatos conspicua; praeterea foliis floribusque discrepat.

Planta 30–45 cm. alta, vix robusta, erecta, simplex, subtortuoso-flexuosa, subaraneoso-puberula vel glabrescens, e tubere circ. 5 cm. longo ovoideo vel ellipsoideo orta; apice tuberis primarii abeunt stolones subterranei, sex vel plures, 30–40 cm. longi, tuberibus terminati, foliis reductis squamiformibus remotis praediti. Folia radicalia mox delapsa, mihi ignota; folia caulina plura petiolo 3–6 cm. longo, supra alte sulcato, basi vaginante, apice anguste alato praedita, latiora quam longiora, ovato-triangularia, rarius 5-gona, plerumque 6–8 cm. longa, 8–12 cm. lata, basi perlate cuneata, saepius truncata, apice acuta vel subacuta, margine nunc aequae nunc irregulariter indurato-dentata, nonnunquam sinuato-lobatula, supra atroviridia puberula, infra pallidiora sparse araneoso-tomentella vel glabrescentia nervis palmatim abeuntibus eminentibus. Inflorescentia terminalis 8–10 cm. longa, basi foliata, folia suprema paulo superans, anguste paniculata, racemis plerumque simplicibus composita, araneoso-puberula; bracteae numerosae lineares vel lanceolatae, 2–4 mm. longae, sparse araneoso-tomentellae; pedicelli bracteis breviores; capitulum floribus apertis 10–12 mm. longum; involucri phylla 5, circ. 8 mm. longa, viridia, glabra, nitentia, fere ad apicem cohaerentia, tubum angustum dentibus quinque brevibus lanceolatis praeditum formantia; flores paulo fragrantés (tunsi odorem *Senecionis Jacobaeae* suggerunt), in capitulo quoque plerumque 4, quorum unus rarius duo ligulati; flores ligulati 1.4 cm. longi, anguste oblanceolati, apice 2–3 denticulati, flavi; flores tubulosi 10–12 mm. longi, flavi; tubus circ. 7 mm. longus; pappus fragilis albus corollae tubum subaequans; antherae ecaudatae.

Central China. — Cultivated in the Royal Botanic Garden, Edinburgh, from seeds (Wilson, No. 1066) received from the Arnold Arboretum in 1909. Plants flowered in July–August 1912, and the above description is based on them. The long tuber-bearing stolons are very striking, and distinguish the plant from any Chinese species known to me. The single ligulate flower (rarely two) in each capitulum is also noteworthy.

PILULARIA GLOBULIFERA, LINN., IN GLAMORGAN.

By M. Y. ORR. (Plate XVII.)

(Read 12th March 1914.)

In the flora of Glamorgan, three separate localities are given for *Pilularia globulifera*, Linn., the earliest record of its occurrence in the county dating from the beginning of last century. Two of the stations mentioned are mountain tarns, in one of which such plants as *Lobelia Dortmanna*, Linn., and *Isoetes lacustris*, Linn., occur. In these hill stations *Pilularia* is extinct, and, at the present time, this plant is found in only one locality in the county, a peaty moorland pool, situated near the hamlet of Welsh St. Donats, about 400 feet above sea-level.

In this pool *Pilularia* is very abundant, and the associated vegetation has much in common with that usually met with in similar situations. On the other hand, certain species which one might expect to find represented there do not occur, although they are frequent associates of *Pilularia* in other countries, and under apparently similar environmental conditions. A brief description of the locality and its flora may therefore not be out of place.

The pool is roughly triangular in outline, and is about 300 yards long. It overlies a substratum of glacial sand and gravel, and is surrounded by a tract of moorland, which merges on all sides into agricultural land. This sheet of water is fed by a short streamlet, which has its source in swampy ground 100 yards distant. At the lower end the outflow is controlled by a sluice-gate. The area is subjected to an annual rainfall of over 40 inches, and the level of the water-surface varies from time to time. The climate is mild, and the freezing of the water is a comparatively rare occurrence, and of short duration.

The water is distinctly peaty, gives an acid reaction, and is poor in the constituents of plant food. A sample of the water was found to contain the following amounts per gallon:—2·127 grains of calcium carbonate. ·837 grain of

magnesium sulphate, and 2.655 grains of potassium and sodium chloride. Pure cultures of *Bacillus vulgaris*, Haus., were also obtained from the sample.

The shores of the pool are treeless, except for scattered specimens of Willow and Alder, while the margin is somewhat gravelly. On the western shore, the bog plants are invading the pool, but the typical reed-swamp, met with in many similar lochs, is absent.

Pilularia is confined to the still, shallow water of the sheltered western shore, and its more immediate associates among the aquatics are *Myriophyllum spicatum*, Linn., and *Potamogeton natans*, Linn., both of which are abundant in the deeper water. On the eastern margin, where the stream enters the pool, *Glyceria fluitans*, Br., is associated with *Eleocharis multicaulis*, Sm., while *Littorella uniflora*, Asch., accompanied by *Apium inundatum*, Reich. fil., occurs in great profusion. Towards the lower end of the pool, *Nitella opaca*, Ag., is frequently met with close to the shore. *Potamogeton densus*, Linn., and *Ranunculus peltatus*, Sch., are also present, while scattered tufts of *Juncus effusus*, Linn., are of common occurrence. Among the Algae noted were species of *Oedogonium*, *Bulbochaete* and *Mougeotia*. *Mougeotia* was found in quantity, entangled with *Myriophyllum*, and it is a point of interest that, although Warming (1909) refers to the Mesocarpeae as being calciphilous, this alga should thrive in water containing such a small percentage of lime.

Epiphytic Diatoms are common on the submerged plants, but Desmids are comparatively rare.

On the muddy shores of the pool, the plants met with are those characteristic of such a situation, and include the following species: *Viola palustris*, Linn.; *Viola lutea*, Sm.; *Anagallis tenella*, Murr.; *Scutellaria minor*, Huds.; *Carex flava*, Linn.; *Equisetum arvense*, Linn.; *Aulacomnium palustre*, Schwaeg.; *Hypnum cuspidatum*, Linn.; *Hylocomium squarrosum*, B. et S.

On the eastern margin, terraces of *Sphagnum subsecundum*, Nees, with its usual associates, fringe the strand, but, behind the *Pilularia* zone, the ground is more boggy, and the Cottongrass is a dominant plant. *Sphagnum* is accompanied by: *Drosera rotundifolia*, Linn.; *Drosera*

longifolia, Linn.; *Orchis latifolia*, Linn.; *Narthecium ossifragum*, Huds.; *Eriophorum angustifolium*, Roth; *Carex echinata*, Murr.; and *Juncus squarrosus*, Linn., in drier situations.

A few specimens of *Salix aurita*, Linn., *Salix cinerea*, Linn., and *Alnus rotundifolia*, Mill., also occur here and there.

Behind the *Sphagnum* zone the typical moorland plants occupy the drier ground. *Erica Tetralix*, Linn., is abundant, while *Pteris aquilina*, Linn., covers large areas of the sloping ground surrounding the pool. Among the grasses represented are *Agrostis setacea*, Curt., and *Sieglingia decumbens*, Bernh.

The distribution of *Pilularia* in Britain and on the Continent of Europe is referred to in the works of Ascherson and Graebner (1896-98), Glück (1911), and other authors, and an examination of these records discloses the fact that *Pilularia* is frequently associated with such plants as *Subularia aquatica*, Linn., *Lobelia Dortmanna*, Linn., and *Isoetes lacustris*, Linn.

In Belgium, according to Massart (1910), *Pilularia* occurs in the "district campinien" at an altitude not exceeding 400 feet, while the ponds of this area also yield *Subularia* and *Lobelia*.

In Northern Germany, Graebner (1901) states that *Pilularia* is more or less confined to the pools of the heather area, and in these situations the same author finds *Lobelia* and *Isoetes* at a low altitude. In his paper "Om Vegetationen i Några Småländska Sjöar," Carlson (1902) recognises *Pilularia* as a constituent of the *Lobelia* and *Phragmites* associations. *Pilularia* is also associated with *Subularia* and *Lobelia* in several of the Irish lakes (Praeger, 1909).

In Scotland, the distribution of *Pilularia* is of particular interest when examined from the point of view of situation and associated species. It is found at low levels in the southern counties, while it ascends to 1000 feet in Perthshire. In his "Survey of Scottish Lakes," West (1910) describes *Pilularia* as being very abundant in Loch Dernaglar (Wigtownshire), about 400 feet above sea-level. The aquatic flora of this loch resembles that of the

Glamorgan station in many respects, but it also includes *Subularia*, *Lobelia*, and *Isoetes*.

Sturrock and Smith (1905) regard these plants as distinctive of the "highland loch" vegetation, which is not confined to high elevations, but is frequently met with almost at sea-level. The lowland lakes of the Faröes, and the moorland pools of Northern Germany, are characterised by a similar aquatic vegetation, while in Southern Germany its typical species ascend to an altitude of 2400 feet (Issler, 1909).

It is thus obvious that, under certain climatic conditions, altitude is not the sole factor which determines the distribution of these "highland loch" types. Graebner (1901) suggests that they owe their presence in these habitats to the paucity of food material in the water, and this theory is supported by Smith in his comparison of the vegetation of highland and lowland lochs in Scotland.

Should the climatic conditions be unfavourable, however, altitude can no longer be regarded as a negligible factor, as is shown by the distribution of these plants in Glamorgan. *Subularia* does not occur in the county, but *Lobelia* and *Isoetes*, according to Trow (1911) and Riddelsdell (1901), have long been established in two upland pools at an altitude of 1500 feet, twenty miles distant from the *Pilularia* station. They are absent from the pool at Welsh St. Donats, although in its general features it closely resembles the type of loch in which these plants occur. The water is practically that of precipitation, while the nature of the substratum presents no apparent obstacle to the successful growth of the species referred to.

It is therefore suggested that, in the milder climate, the altitude factor does play a not altogether unimportant part in the distribution of *Lobelia* and *Isoetes*, while, in their more northern stations, the climatic factor would account for their occurrence at low levels.

The introduction of these two plants into the pool at Welsh St. Donats, on the lines of experimental ecology, might be productive of some interesting results.



The Lower Pool, Welsh St. Donats, from N.W.



The same, from the N.E., looking across to the *Pilularia* zone
(Photo. A. W. Sargent.)

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TWO NEW LEGUMINOSAE. By Dr. A. K. SCHINDLER.

(Read 11th June 1914.)

Campylotropis Howellii, Schindler. Sp. nov.

Frutex erectus ramis virgatis lineatis breviter adpresse pilosis. Folia stipulis lanceolato-subulatis 4-5 mm. longis et petiolo ad 2.5 cm. longo piloso et rhachi 0.2-0.5 cm. longa praedita, stipellas non vidi. Foliola oblonga ad ovalia apice retusa vel leviter emarginata mucronulata, supra glabra, subtus sparse breviterque adpresse sericea, terminale ad 2.5 cm. longum et ad 2.1 cm. latum, lateralia paullo minora. Racemi axillares et terminales in paniculam collecti, longe pedunculati, cum pedunculo ad 4 cm. longo, ad 10 cm. longi, densiflori; bracteae stipulis similes anguste lanceolatae, longe acuminatae, 5 mm. longae, breviter adpresse pilosae, infimae 1 vel 2 persistentes, ceterae mox caducae; pedicelli perbreves 1.5-3.5 mm. longi, breviter subadpresse pilosi, calyce semper breviores; bracteolae lineares, 2.5 mm. longae, caducae. Calyx breviter adpresse pilosus tubo 2-2.5 mm., laciniis angustis acutissimis 2.5-3.5 mm. longis, posticis 2 alte connatis apice vix 1 mm. sejunctis. Corolla calycem duplo super-

ans petalis aequilongis 10 mm. longa, vexillo apiculato 6 mm. lato, alis 3·2 mm. latis, carina parte inferiore circiter 7 mm., superiore 5–6 mm. longa. Legumen (immaturum tantum) late lanceolatum stipitatum ubique breviter adpresse sericeum, margine subadpresse ciliatum.

China, N. W. Yunnan.—Teng-yueh (E. B. Howell, n. 6!). Herb. Edinb.

Alysicarpus Brownii, Schindler. Sp. nov.

Alysicarpus longifolius, Benth., "Fl. Austr.," ii. 239 (ann. 1864), excl. syn. cit.

Suffrutex? ascendens vel erectus caule glabro superne distincte angulato circiter 75 cm. alto. Stipulae scariosae striatae lanceolato-setaceae ad 25 mm. longae glaberrimae. Folia simplicia petiolo brevi sulcato glabro ad 1 cm. longo et stipellis scariosis 1–2 mm. longis praedita, linearia acutissima mucronata ad 10 cm. longa et 0·6 cm. lata coriacea, margine leviter recurva, subtus ad medianam et ad margines sparse adpresse pilosis, ceterum glabris, nervis secundariis brevibus mox in reticulum in utraque facie crasse prominens dissolutis. Racemi terminales et axillares laxiflori ad 22 cm. longi rhachi brevissime dense uncinato-pubescente; bractae ovatae brevi acumine apicem versus adpresse ciliatae dorso brevissime uncinato-pilosae 5–6 mm. longae caducae; pedicelli 2–3 mm. longi dense uncinato-hirti. Calyx circiter 6 mm. longus, tubo 2–5 mm., laciniis lanceolatis acutissimis ubique pilis sparsis strictis longis brunneis et brevissimis uncinatis plurimis obsitis 3–3·5 mm. longis, posticis ad dimidium conuatis paullulo brevioribus. Corolla calycem $1\frac{1}{2}$ -plo superans ultra 8 mm. longa (fragmentis tantum visis), petalis angustis. Ovarium 5-ovulatum dense brevissime uncinato-pubescent cum stylo longo adpresse piloso geniculato 8 mm. longum. Legumen compresso-cylindricum 3–4-articulatum (immaturum) ad 2·2 cm. longum et 3 mm. latum ad septa leviter incrassatum, articulis leviter reticulatis dense brevissime uncinato-pubescentibus, infimis et mediis $1\frac{1}{2}$ -plo longioribus quam latis, summo longiore, calyce articulum infimum non superante.

Northern Australia. — (R. Brown, "Iter australiense," 1802–5, No. 4176). Herb. Edinb.

Nearly related to *Alysicarpus vaginalis* (L.) DC., although very different in its general habit.

THE SCOTTISH ALPINE BOTANICAL CLUB EXCURSION,
1913. By ALEXANDER COWAN.

(Read 14th May 1914.)

The members met at Fort William on Monday, 28th July, the principal object being, if possible, to re-discover *Saxifraga caespitosa*, Linn., leave having been kindly granted by Sir Peter Walker, the tenant of Inverlochy Forest, to explore his ground. As Tuesday the 29th was very fine, the members left Fort William by an early train for Spean Bridge, from which point they made their way to Killichonate, where they were met by the head stalker, who kindly placed his son and a couple of hill ponies at the disposal of the party during the day. After fully three hours' walking over ground at first fairly level and afterwards very steep, the party reached a ridge along which they passed for about half a mile, then they descended to the Castle Rock, and although careful search was made by the whole party on all the likely rocks in the Corrie, only one of them was fortunate enough to find a single plant of the rare *Saxifraga* already referred to. On this day the following plants were found:—

Thalictrum alpinum, Linn.; *Silene acaulis*, Linn.; *Cerastium trigynum*, Vill.; *Saxifraga stellaris*, Linn.; *S. aizoides*, Linn.; *S. caespitosa*, Linn.; *S. hypnoides*, Linn.; *Parnassia palustris*, Linn.; *Sedum roseum*, Scop.; *Epilobium anagallidifolium*, Lam.; *Solidago Virgaurea*, Linn., var. *cambrica* (Huds.); *Hieracium holosericeum*, Backh.; *Vaccinium Vitis-Idaea*, Linn.; *V. uliginosum*, Linn.; *Arctostaphylos alpina*, Spreng.; *Azalea procumbens*, Linn.; *Oxyria digyna*, Hill; *Salix herbacea*, Linn.; *Empetrum nigrum*, Linn.; *Luzula spicata*, DC.; *Rhynchospora alba*, Vahl.; *Carex pulicaris*, Linn.; *C. pauciflora*, Lightf.; *C. stellulata*, Good.; *C. rigida*, Good.; *C. pulla*, Good.; *Cryptogramme crispa*, Br.; *Polystichum Lonchitis*, Roth; *Athyrium alpestre*, Milde; *Lastrea dilatata*, Presl, var. *alpina*; *Lycopodium Selago*, Linn.; *L. clavatum*, Linn.; *L. alpinum*, Linn.

Owing to the heat of the day and the distance walked

the party were thoroughly tired out when they reached Killichonate in the evening, but they were most hospitably entertained to tea by the head stalker and his wife, a kindness which was highly appreciated by all. As there was no train back, the party drove from Spean Bridge to Fort William.

On Wednesday, 30th July, the members again went by early train to Spean Bridge in order to botanise in Glen Larich, also part of Inverlochy Forest. They drove a considerable part of the way over a rough hilly road leading up the valley. The day was again delightfully fine, and a very pleasant though easy day was spent. The rocks here are rather dry and barren, but the enormous quantities of fern growing on the slopes of the valley facing east made up for the absence of rare plants, especially as some good varietal forms were found. The following plants were found:—

Lathyrus montanus, Bernh.; *Melampyrum sylvaticum*, Linn.; *Orchis incarnata*, Linn.; *Juncus conglomeratus*, Linn.; *Eriophorum vaginatum*, Linn.; *E. angustifolium*, Roth; *E. latifolium*, Hoppe; *Carex stellulata*, Good.; *C. curta*, Good.; *C. pilulifera*, Linn.; *C. pallescens*, Linn.; *C. panicea*, Linn.; *C. binervis*, Sm.; *C. flava*, Linn.; *Asplenium viride*, Huds.; *Lastrea montana*, T. Moore; *Phegopteris Dryopteris*, Fée; *P. polypodioides*, Fée.

The members returned to Fort William in the evening by train

On Thursday, 31st July, the party drove east to a point due north of Ben Nevis in order to spend the day in the Corrie of this mountain. There was considerable mist well down the face of all the hills, on account of which great difficulty was found in striking the proper direction to the Corrie. However, it was eventually reached, and, as the mist lifted and the weather improved, a pleasant day was spent. The following plants were found:—

Silene acaulis, Linn.; *Cerastium alpinum*, Linn.; *Saxifraga stellaris*, Linn.; *S. hypnoides*, Linn.; *Sedum roseum*, Scop.; *Epilobium alsinefolium*, Vill.; *Saussurea alpina*, DC.; *Statice maritima*, Mill.; *Veronica alpina*, Linn.; *Rhinanthus Drummond-Hayi*, Druce; *Oxyria digyna*, Hill; *Habenaria conopsea*, Benth.; *Juncus trifidus*, Linn.;

J. triglumis, Linn.; *Carex pauciflora*, Lightf.; *C. stellulata*, Good.; *C. rigida*, Good.; *C. pulla*, Good.; *Cryptogramme crispa*, Br.; *Athyrium flexile*, Syme; *Lastrea dilatata*, Presl, var. *alpina*.

Athyrium flexile, Syme, was found in great quantity and, along with *A. alpestre*, Milde, was growing in great luxuriance and beauty.

The members returned home on Friday, 1st August, having spent a short but very pleasant visit in this interesting district.

VARIATIONS IN THE GROWING REGION. By Miss ROSALIND CROSSE, B.Sc. (Plates XVIII., XIX.) Communicated by R. A. ROBERTSON, M.A., B.Sc.

(Read 11th June 1914)

The results embodied in this paper are the outcome of investigations on the growth periodicity of roots and shoots. Last year, when tabulating the results of experiments on the correlation between root and shoot rhythms and calculating the rates of growth, I found that to obtain the growth coefficients for these organs under the various conditions of experimentation it was necessary to know the length of the growing region in each case and to ascertain if it were constant.

Sachs' measurements showing the region of greatest growth behind the tip of the root of *Vicia Faba*, are well known. He gives the total growing region as usually 10-11 mm., and states that it varies in different roots, and that the transverse zones making up the whole growing region begin to grow slowly, then more and more rapidly, attaining a maximum growth, and then decrease and finally cease altogether.¹

Whether the growing region varies under different external conditions he does not say.

As far as I know, no experiments were made by him with the shoots of *Vicia Faba*, though measurements were made after forty hours on plants in which one or more zones had stopped growing, because in younger plants

¹ Sachs, "Lectures," p. 542.

the whole stem is in a state of elongation.¹ He found that the growing region increased with the activity of growth, and each transverse zone increased to a maximum, and finally ceased altogether as in the root.

No definite statement is made as to the necessity for repeated measurements on the same plant at definite short intervals or in regard to the possibility or probability of variation under different conditions.

Pfeffer² states that the relation between the regions where growth by cell division and growth by cell stretching are active differs in stems as well as in roots, and the total length of the growing region may also vary considerably; further, that changes must occur whenever the relationship between the vegetative and elongating zones is disturbed by internal or external agencies.

Thus the length of the growing zone usually increases when growth becomes more active,³ and also when the stem is etiolated, while the temperature⁴ supply of water and other external factors may also influence it.

The relationship between temperature and the growing region was studied by Askenasy.⁵ He found that the growing region was bigger at a lower temperature than at a higher—for instance, larger at 18° than at 27°.

In the experiments given below the temperature was kept within small limits.

Some of the problems which suggested themselves at the outset were:—

I. Do the lengths of the growing regions in roots and shoots of the bean vary regularly or irregularly from day to day under normal constant external conditions?

II. Are the growing regions affected by different conditions of light and darkness?

For instance, does the growing region increase in the dark with the abnormal increase in length of the stem, or does it remain the same; in other words, is the "rapidity of growth" greater in the dark, or is it due to the abnormal length of the growing zone, as is the case with some climbing plants?

¹ Sachs, "Flora," 1873, p. 322.

² "Physiology of Plants," vol. ii. p. 11.

⁴ Askenasy, "Ber. d. Bot. Ges.," 1890, p. 82.

³ Sachs, *loc. cit.*

⁶ *Loc. cit.*

On the other hand, is the less growth of plants continually in the light due to a shorter growing region?

III. What is the comparative effect of these conditions on the growing region of root and shoot?

METHODS.

Beans were grown in tap-water cultures under four sets of external conditions of light and darkness:—

I. *Normal conditions*, i.e. shoot in intermittent light and darkness and root in the dark.

II. *Intermittent conditions*, i.e. shoot and root in intermittent light and darkness.

III. *Dark*.—Both in the dark day and night.

IV. *Light*.—Both in the light day and, night. (Two electric lights, one of fifty and another of twenty-five candle power, were used at night, giving a diffuse light.)

The temperature conditions were uniform for all the experiments, with 19° and 24° C. as limiting temperatures. The humidity varied during the periods of experimentation between 40 per cent. and 65 per cent.

Experiments I. and II. were carried on during the months of November and December, when the proportions of light to darkness were 9-15 and 8-16 hours respectively; numbers III. and IV. during February, when the proportions were 10-14 hours.

The roots having an initial length of 20-30 mm. were marked with Indian ink with a fine sable brush in 1 mm. divisions, over a length of 15 mm. from the tip, then in lengths of 5 mm. to the base. Daily measurements of growing regions and the total lengths of the roots were recorded.

The shoots were marked as soon as possible by hand in 5-mm. divisions from the growing point (as nearly as possible) and in 1-mm. divisions towards the base of the stem; afterwards a special marker was used, the familiar rubber-wheel marker having proved unsuitable for the particular purpose. I devised a flat rubber stamp graduated in 1 and 5 mm.—that is 15 mm. length over all.

Care was taken to prevent desiccation or damage to the organs while they were being marked or measured.

RESULTS.

TABLE I.

	I. Normal.	II. Inter- mittent.	III. All Dark.	IV. All Light.
Shoot	66.5	62.3	45.8	58.1
Root	10.85	9.67	9.1	8.1

The above table, constructed from numerous careful observations of measurements, gives the average lengths in mm. of the growing regions of shoots and roots respectively under various conditions.

Reference to the figures will show that the varying conditions have a direct influence on the length of the growing region of both root and shoot.

Any change from the normal conditions is accompanied by a decrease in the growing region, which differs for each condition, being progressively smaller for the root for the conditions in the order stated in the table. There is an exception for the shoot in the numbers III. and IV., which are the reverse of the root.

The figures in column III., considered in conjunction with column I., prove that etiolation diminishes the actual length of the growing region, and consequently that the great elongation of an etiolated shoot is entirely the result of increased growth activity and not in any degree consequent on elongation of the growth region, which is, as already stated, shorter than the normal.

This is, contrary to Pfeffer's statement,¹ based on Strehl's views that the growth region increases in etiolated shoots. It will be obvious that the decrease in length of the growing region under Intermittent light conditions is a correlative effect due to interaction between root and shoot, resulting from the exposure of the root to light during the daytime. In Light the growing region of the shoot is less than in the Normal, though it is larger than in the Dark,

¹ *Loc. cit.*

while the growing region of the root is less than in any of the others, including the Dark.

TABLE II.

	I. Normal.		II. Intermittent.		III. Dark.		IV. Light.	
	Av. Incr. Gr.	Av. Incr. Gr. Reg.	Av. Incr. Gr.	Av. Incr. Gr. Reg.	Av. Incr. Gr.	Av. Incr. Gr. Reg.	Av. Incr. Gr.	Av. Incr. Gr. Reg.
Shoot.	204.5	75	187.6	73.6	221.3	47.3	160.6	66.6
Root.	119.8	5	108.1	3	134.3	2.6	96	2

Table II. shows the average increase in mm. in the growth of roots and shoots and the increase in the length of the growing region for the same periods under the four sets of conditions, beginning with organs of approximately equal length.

This, in the main, bears out the conclusion, based on Table I., of mean growing regions in roots and shoots, and also gives a comparison between the actual increase of growth in length of the organ and the increase of the growing region.

It shows that the growth and the length of the growing regions vary in the same manner, except in the case of etiolated plants.

The actual growth in length of the etiolated shoot is greater than in any of the others, while the growing region is smaller; while in the root the growth in length is more than in any of the others, but the growing region is less than in all the others except IV. (Light).

In the Light shoot the increase of growth is least of all, and the growing region smaller than Normal or Intermittent, but bigger than in the Dark.

In the root in the Light both are smaller than any of the others, probably due to retardatory effect of light on the root.

The graphs appended (Plates XVIII., XIX., figs. I., II., III., and IV.) are plotted from tables giving the lengths of the organs—root and shoot—from day to day and the figures obtained for the increase of growth every twenty-four

hours, with the lengths of the growing regions for that period under the four sets of conditions above mentioned.

Several experiments were carried on, and the conclusions are based on these, but only one of each has been selected as typical for the conditions given.

These graphs show very clearly the increase and decrease in length of the growing regions from day to day, following very closely in most cases the daily increase in the growth, though no definite relationship can be made out between them.

All the curves are very similar in character.

DESCRIPTION OF THE GRAPHS.

G.R.—Lengths of growing regions every twenty-four hours.

G.I.—Growth increase every twenty-four hours.

Plate XVIII. (I.) Under the Normal conditions the two curves generally vary together in both organs, showing an increase, followed by a slow decrease.

(II.) Under Intermittent conditions the two curves of the shoot vary together.

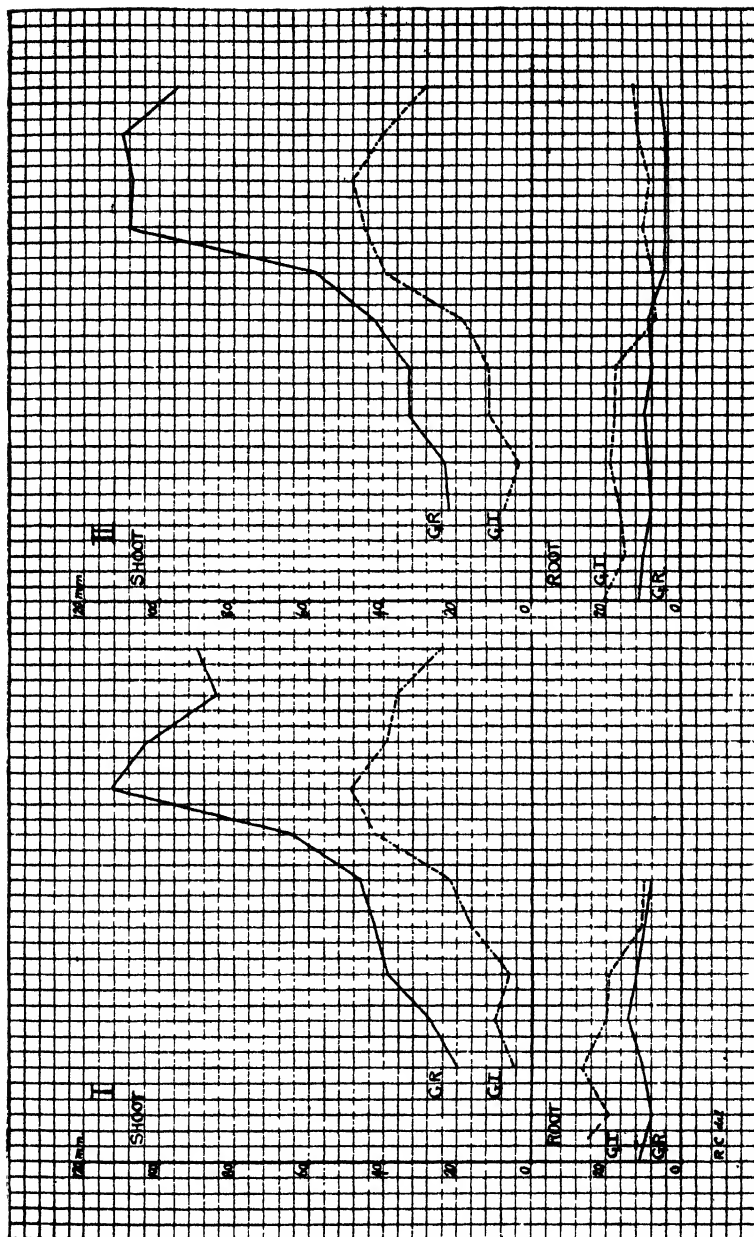
In the root they vary together very closely at the beginning, but the growing region curve flattens out more later on. In the root the curves have only a downward portion, probably due to the retardatory effect of light. In comparison with I. all the curves show a diminution in height.

Plate XIX. (III.) Under the conditions of Darkness the two curves of the shoot have a tendency to diverge from the correlative variation so characteristic of the others. In comparison with I., II., and IV., the curves bring out the fact, previously mentioned, that the growth increases, while the growing region decreases.

In the root the two curves vary a little: the growth increase curve first decreases, then increases, though not to so high a point, then decreases again; while the growing region curve decreases and finally flattens.

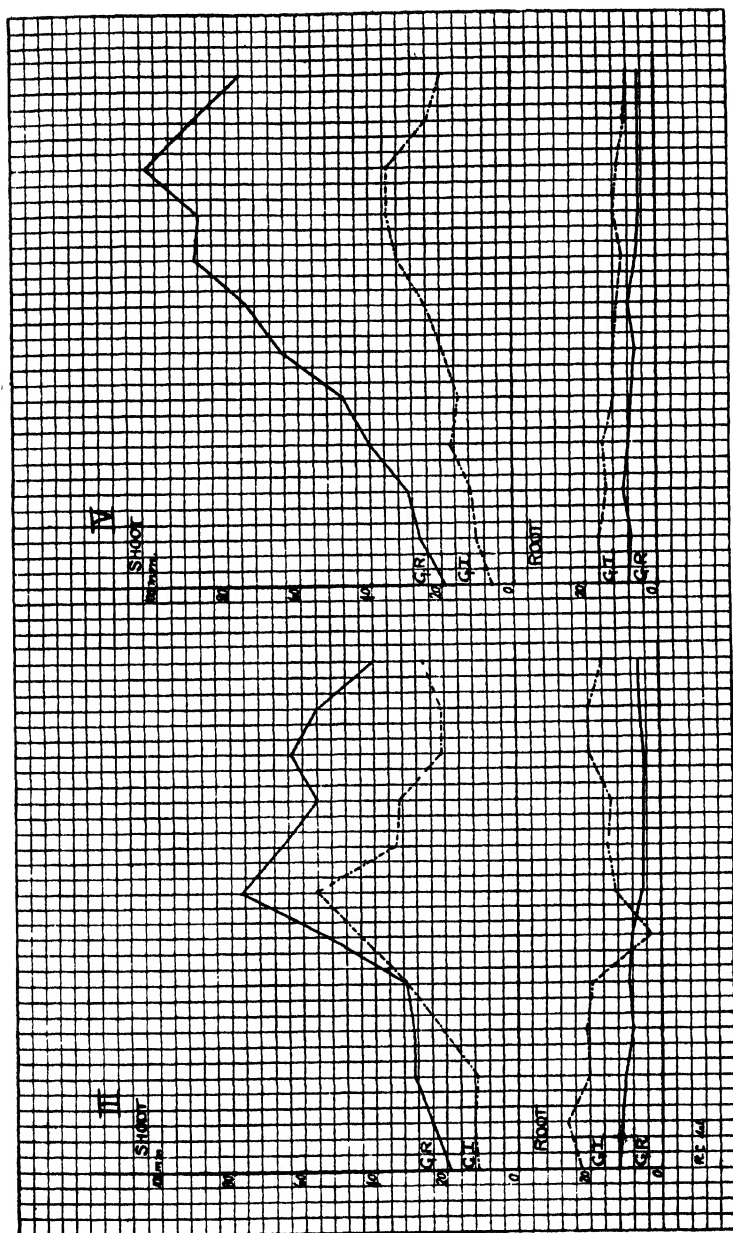
The growth curve in this particular case is as high as I., but higher than II.; while the growth region curve is less than I. and II., but higher than IV.

(IV.) In the Light continuously the two curves of the shoot vary together and show that the growth is less than



Graphs showing Variations in the Growing Region.

Miss R. CROSSE.



Graphs showing Variations in the Growing Region.

Miss R. CROSSE.

in all the others, while the growing region, though less than I. and II., is greater than III.

In the root the two curves vary together, also at the beginning, but the growth region curve flattens out later. In comparison with the others the two curves show a diminution in height, though the growth curve is about the same as II. These curves show a slight increase at the beginning followed by a decrease, probably due to the after effect of the normal conditions later overcome by the retarding influences of the light.

There is a correlation between the growing region of root and shoot, the latter increasing as the former is on the decrease, as is the case of the growth in length.

CONCLUSIONS.

(For roots of *Vicia Faba*.)

1. Daily variations, irregular in character, occur in the lengths of the growing regions of root and shoot under ordinary conditions.

2. The growing region in the shoot varies very little in Intermittent conditions from the Normal.

It varies most in the Dark, when it decreases, even though the growth in length increases.

In the Light the growing region decreases, but to a less extent than in the Dark, while the growth also decreases.

3. The growing region of the shoot varies very closely with the increase of growth from day to day, and the maxima of both correspond under all the conditions.

4. The growing region in the root varies under the conditions II., III., and IV., and is evidently more easily influenced than that of the shoot.

E.g. In the Normal the growing region slowly increases, then decreases.

In the Intermittent the growing region decreases, then remains uniform.

In the Dark the growing region decreases, then remains uniform.

In the Light the growing region increases for a short time, then decreases and remains uniform.

5. The growing region in the root varies with the growth

from day to day in the Normal. In the Intermittent and Light conditions the growing region curve flattens towards the end, while in the Dark the growth curve decreases, then increases and decreases again, while the curve of the growing region decreases and then flattens out.

6. The growing regions, as well as the growth increase of root and shoot, show a similar correlation, i.e. they vary inversely.

NOTE ON PHYLLODY AND DIATROPISM IN THE PRIMROSE.
By Miss FLORA M. SCOTT, M.A., B.Sc. (Plate XX.) Com-
municated by R. A. ROBERTSON, M.A., B.Sc.

(Read 11th June 1914.)

In Mount Melville Woods I found a curious "thrum-eyed" sporting form of *Primula vulgaris*, Huds. It was growing at the foot of a steep bank near the valley of a small stream, in a stiff clay soil. The undergrowth was scanty, consisting mainly of primroses and ferns. The primroses, with this one exception, were normal.

The sporting plant was large and well grown, and was noticeable at a glance on account of the remarkable habit of the flowers. The calyx was leafy, and the corolla, normally oriented in bud, assumed a horizontal position on further development, being bent over at the base of the corolla tube. A flower, normally radial, had thus assumed directly zygomorphic symmetry. Along with zygomorphy was associated a certain amount of irregularity in the floral envelopes.

The number of sepals varies from five to seven, the most usual number being six. They are foliose, and are differentiated into leaf-base and lamina. The leaf-bases in bud are connate, and are united by a thin colourless membrane, three to five cells thick. The outer and inner epidermis of the latter are continuous with those of the leaf-base. The middle layer is non-chlorophyllous parenchyma. On further development of the flower, chorisepaly occurs, resulting in the complete freedom of one or more sepals. The laminae are lanceolate, and in general appearance and venation resemble the primrose leaf. There is a certain

amount of variation in the length of the laminae, longer and shorter as a rule alternating. The base of the calyx is very woolly. From this point there arise, in the majority of specimens, small reddish cylindrical papillae which vary in length from 1 to 20 mm., and in diameter from .5 to .75 mm. They arise in line with the sepal or are inter-sepaloid in origin. They are downwardly directed, being either free or fused for part or the whole of their length to the peduncle. The tip is slightly invaginated. On sectioning they are found to be solid and to consist of loose spongy parenchyma. Except for the presence of two nuclei in certain cells, the tissues are perfectly normal.

In the corolla likewise there is variation in the floral number, and, as in the calyx, six is most usual. Where dedoublement occurs, the laminae, in addition to the sepal bases, may be connate. In one specimen, however, the corolla tube was split posteriorly along its whole length. There is a marked tendency to phyllody along the petal margins, but in no case has the whole petal become leafy. The plane of symmetry is interpetaloid. The bending of the corolla-tube is accompanied by transverse wrinkling along the anterior, *i.e.* the concave surface. On the posterior surface the cells have undergone stretching growth, and are elongated and more or less rectangular, while anteriorly the tissues appear correspondingly compressed. This is indicated by the external wrinkling referred to, and by the shape of the cells, which are short and oval. Sometimes on the anterior surface there occur longitudinal ridges, reddish in colour and woolly. These run the whole length of the corolla tube and extend half-way or to the tip of the lamina. They are due to proliferation of the mesophyll, some cells of which are pigmented.

The androecium shows a slight tendency to dedoublement and to phyllody. The filaments vary in length, but this variation is not correlated in any way with the floral zygomorphy.

The gynoecium is normal, except that the style is somewhat short, being shorter than the usual short-styled type, and bent anteriorly parallel to the line of curvature of the corolla. Sectioning revealed no abnormality either in ovary

or in ovules. In the pith cells of the peduncle, at the level of insertion of the corolla, there was found a greater accumulation of starch granules than in the normal flower.

No trace whatever of insect attack, of fungus mycelium, or of any other such stimulus has been detected.

Various experiments were performed with a view to determining the influence, if any, of gravity and light on the curvature of the corolla. The specimens selected for experiment were both young and old, the former being still straight in bud, the latter already bent. The amount of curvature is measured by the angle subtended by the peduncle and the middle line of the corolla tube. The flowers were fixed in water, in test tubes, and experiments were carried on in dark and in light.

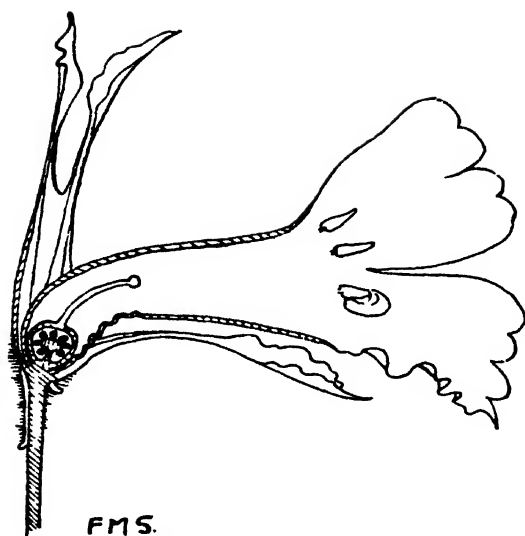
1. *Geotropism*.—Buds, when fixed vertically and kept in the dark, expanded slightly, but showed no curvature, even after the lapse of four days. From this it may be inferred either that gravity alone is insufficient to induce curvature, or that in the absence of light as a tonic condition no response is made.

From experiments with adult flowers conflicting results were obtained. One whose angle of curvature was 40° was fixed with the peduncle upright. The angle of curvature increased by 13° in three days. This appears to be an attempt on the part of the flower to reassume its diatropic position. On the other hand, two flowers whose angles of curvature were 90° , were fixed, peduncles horizontal and corolla tubes vertical, one pointing upwards and the other downwards. No movement from the erect position was observed. Presumably the inference to be drawn is, as in the first case, viz.: either that gravity has no effect, or has no effect in the absence of light.

2. *Geotropism and Heliotropism*.—In the following experiments the flowers were unilaterally illuminated, and the force of gravity was not eliminated.

Of the four buds experimented upon, two being placed horizontal and two vertical, only one of the former showed any movement. It curved slightly upwards towards the light.

In the case of adult flowers one increased its angle of



Phyllody and Diatropism in the Primrose.

curvature, while in the other the angle was diminished. The peduncle of the former, in its natural position on the plant, was inclined at an angle of 60° . It was fixed vertically and the corolla tube unbent upwards through 25° —from 110° to 135° . In the latter the peduncle was fixed horizontal, the corolla upwards. The angle of curvature decreased from 120° to 40° .

From the above experiments it appears that gravity alone is unable to induce curvature, but that gravity and light combined may exercise a directive effect, within limits, on curvature already begun.

To summarise, the most remarkable points in this sport are:—

1. The phyllody and chorisepaly of the calyx. The former is not an uncommon occurrence, and has been frequently recorded.

2. Diatropism and zygomorphy of the corolla. The transition from radial to zygomorphic symmetry is held to be the result of a long period of evolution. Here, in the ephemeral lifetime of a single flower, the process is initiated and completed. The curvature, it is concluded, is either due to some stimulus, undetected but present in the flower, and is therefore pathological, or it is simply a variation. It will be of interest to observe the development of the flowers next spring, and the behaviour of the seedlings, should any seeds mature.

TRANSACTIONS
OF THE
BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXIX.

PRIMULA OBCONICA AND ITS MICROFORMS. By
Professor BAYLEY BALFOUR, F.R.S. (Plates XXI-LVI.)

(Read 10th April 1913.)

The plant we know as *Primula obconica*, Hance, was described from specimens collected about Ichang in West Hupeh, in 1879, by Consul T. Watters. It was gathered in the same year in the gorge formed by the Yangtze at Ichang by Charles Maries, collector for Messrs. Veitch & Sons of Chelsea. There is no previous record of the plant. Raised at Chelsea by Messrs. Veitch from seed sent by Maries, it flowered in September 1880, and the plant was awarded a first-class certificate by the Royal Horticultural Society in 1882. A figure of it under the name *P. poculiformis*, Hook. f., appeared in the Botanical Magazine of September 1881—a name which has had to yield to the earlier one given by Hance.¹

Its popularity as a garden plant has been affected adversely by the property it possesses of causing troublesome irritation of the skin to some of those who handle it. The property is not confined to *P. obconica*, Hance, amongst primulas. *P. sinensis*, Lindl., and *P. Sieboldii*, E. Morren, possess it also, but in a degree so much less as to give little occasion for remark amongst cultivators; and it has been observed in some other species.

¹ Hance in Journ. of Bot., xviii (1879), 234.

The irritation caused by *P. obconica*, Hance, comes from a yellow substance, out of which monoclinic crystals separate, which issues from the hairs which cover it in all its parts. Anyone touching the plant receives a deposit of this upon the skin, and by anyone so infected, if one may so say, the infection may be conveyed to others by touch; that is to say, the ailment is contagious only. There is no question of an exhalation or of a microbe conveyed through the air. The infective substance is soluble in alcohol, chloroform, turpentine, benzole, and this gives suggestion of protection — apart from exclusion of the plant from cultivation—to those who are susceptible. Washing the parts that have touched the primula immediately after tending will dissolve the hurtful secretion and remove it. Once the itching has begun, ordinary palliatives in skin irritation—zinc ointment with boracic acid, for example—must be used. Here in Edinburgh, whether on account of the pachydermy of its people or because the secretion is less virulent than it is elsewhere, cases of dermatitis caused by the plant are few. No case has been recorded from the Royal Botanic Garden, where the plant has been cultivated since its introduction. Probably the number of individuals susceptible is everywhere small, but the irritation in those attacked may be severe, and the brand of popular prejudice has given the plant a bad name which sticks to it.

It is a misfortune for horticulture that a plant so desirable for winter decoration of our greenhouses should have attached to it this curb upon popularity; the more gratifying, therefore, is it that we have now the prospect of an *obconica* race free from the offending habit of *P. obconica*, Hance, itself. *P. obconica*, Hance, as we know it from Ichang, is apparently the eastmost extension of a type which in varying degrees of development extends into Manipur and Sikkim, where it becomes—shall I say—what is known as *P. Listeri*, King. Over the area of distribution variations occur, and amongst them is that in the direction of suppression of the infecting hairs, whilst the plant retains its qualities of growth-form and flower which have given the Ichang plant its horticultural value. Such an innocuous form is amongst the recent accessions

to gardening plants from the flora of China, and should the expectation I hold out be realised, this introduction by Messrs. Bees, Ltd., through their collector George Forrest, will be not the least of their services to horticulture.

The plant I speak of was introduced as *P. Listeri*, King. It is not, however, the Indian plant, which is not yet certainly in cultivation, but a microform intermediate to *P. obconica*, Hance, and *P. Listeri*, King. It is now named *P. sinolisteri*, Balf. fil.

In dealing with the type of *obconica* — or better, *obconico-Listeri*—amongst primulas, as I propose, I am conscious that the material which I have been privileged to examine—rich though it be—is by no means sufficient to justify a conclusive discrimination of the forms of the type spread over the area from which it is known, nor to determine their relations to habitat and to one another. There is not indeed in all the herbaria of the world material as yet accumulated adequate for this, and it will be long before this stage of satisfactory aggregation is reached. To await accessions before publishing results of such analysis as is possible now would mean sacrificing an occasion for emphasising the fact that *P. obconica*, Hance, is not in all its forms a hurtful plant, and of recording some other facts which are contributions to natural knowledge. I therefore present a series of illustrations of this *obconico-Listeri* type, and will explain the conclusions to which they seem to me to lead.

Plate XXI shows the type-specimen of Hance's description now in the Herbarium of the British Museum. I have to thank Dr. Rendle, Keeper of the Department of Botany of the British Museum, for his kind permission to have the photograph taken and to reproduce it here.

In Plate XXII we have a figure of a plant collected by Wilson (No 121) at S. Wushan, and Plate XXIII shows a specimen in the Paris Herbarium collected by Delavay (No. 317 *bis*) on the banks of the Blue River (*i.e.* the Yangtze)¹ at Che-pa-to in Szechwan. S. Wushan and

¹ I am indebted to Mr. Brewitt Taylor of the Chinese Maritime Customs for the information that the Blue River of French writers is the Yangtze.

Che-pa-to are stations a little further west than Ichang, and the specimens figured seem to tell us that in this form *P. obconica*, Hance, has a distribution of some extent in Western Hupeh and Eastern Szechwan.

Plates XXIV and XXV show specimens of the *P. obconica*, Hance, of cultivation, and they fairly represent an ordinary form that is met with in greenhouses. That they are the same form as was collected by Maries at Ichang and also by Wilson and Delavay is beyond doubt.

What are the characters of this *P. obconica*, Hance? ¹

We have a multicapital perennial of glaucous hue with a cluster of petiolate cordate rotundate or elliptic or oblong or ovate leaves coming from the crown. The plant forms a distinct rhizome—well seen in Delavay's specimen, No. 317 *bis*—upon which the remains of previous generations of leaves are visible, and from this rhizome short stolons may be given off, ending in the leaf-tufts. The length of petiole and size of lamina differ somewhat with the position of the leaf in the cluster. The petiole may about equal the length of the lamina, be shorter or longer than it. Its base is dilated into a definite clasping vagina. The blade is leathery, always obtuse at apex, cordate at base, and the margins are slightly undulate or sinuate with low wide crenatures, or sometimes with blunt or acutish shallow lobes, and always there is present a minute denticulation usually caused only by the projecting corneous hydathodal end of the primary or also secondary veins.

The whole plant has a pubescence of short hairs, but in

¹ The following is a transcription of Hance's description in Journal of Botany, xviii (1879), 234.—

"*Primula obconica*, Hance, sp. nov. Foliis rosulatis tenuibus subrotundo-ovalibus basi cordatis lobis saepius incumbens apice obtusissimis margine repandis supra parce hirtis opacis subtus pallidioribus nervis pilosis petiolis usque aequilongis fulvo-villosis, scapis folia 2-3-plo superantibus pilosulis 10-20-floris, floribus umbellatis, involucri foliolis lineari-setaceis pedicellis longis divaricatis subtriplo brevioribus, calyce pubero e basi acutissima obconica ad trientem longitudinis in dentes latissime semiovatos mucronulatos diviso, corollae hypocrateriformis roseae tubo calycem duplo superante lobis oblongis retusis, capsula parva globosa, stylo tenuiter capillari tubum corollinum fere adaequante.

"In prov. Hupeh, circa Ichang, vere 1879, coll. cl. T. Watters. (Herb. propr. n. 21,000.)

"Affinis *P. sinensi*, Lindl., *P. cortusoidi*, Linn., et *P. Kauffmannianae*, Rgl.; a cunctis tamen, foliis haud lobatis calycisque forma egregie distincta."

addition there may be a villous covering of articulated hairs. To this I shall refer presently.

From this foliage tuft ascend one or more scapes which overtop the leaves and often curve outwards through the foliage before ascending vertically to end in an umbel of six up to twenty flowers on strict pedicels, between which there is so marked a time interval in evolution and expansion that the first opening flower may be in full anthesis at the end of its pedicel when those which will open last are still in bud and have no pedicel to speak of. An inequality in length of pedicel is thus a conspicuous feature in the umbel. The bracts are small linear or linear-lanceolate structures much shorter than the pedicels. In cultivated specimens there may be a whorl of flowers some distance below the terminal umbel. Neither in the form I am dealing with nor in any other form of *P. obconica*, Hance, from a wild station have I seen this tiered arrangement.

Each flower has a cup-shaped calyx with short teeth and broad lobes, each with a mucro, and may nearly conceal the corolla-tube, or this may be about twice the length of the calyx. The lilac or purplish corolla-limb has an eye, and there is a slight annulus at the top of the corolla-tube, and the limb expands into broad obcordate bilobed rounded segments. *P. obconica*, Hance, is one of those species in which, in the short-styled flower, the style is very short, and the stamens are inserted some distance below the top of the tube, which forms an ampliate chamber above their insertion, and does not exceed in length the calyx by so much as is the case in the long-styled flower. The style in the long-styled flower reaches close to the top of the corolla-tube; the tube regularly widens upwards, is much narrower than the tube of the short-styled flower, and it also far exceeds in length the calyx; and the stamens are inserted low down, well within the calycine investment. In fruit the calyx is accrescent, doubling in size and enclosing the capsule which when ripe is somewhat top-shaped, its crustaceous summit marked by five grooves of the carpellary valves with the persistent style in the centre. The lower part enclosed in the calycine tube is thin and somewhat membranous. The valves do not always separate.

The whole summit may break off, or the style may be detached with a portion of the summit, leaving a central hole for escape of the seeds.

The vestiture of hairs possessed by the plant calls for special notice. The petioles are densely clad in a villous fashion with long articulate hairs which are sometimes white, sometimes brown—the joints in the dried plant showing markedly a brown or reddish coloration. These hairs extend along the main veins of the leaf and may give a ciliate edging to it, but here the hairs are shorter. They do not occur upon the upper surface of the leaf, or upon the under surface, apart from the veins. These areas are, however, coated by short scabrid hairs which tend to disappear in the older leaves, and the upper surface then becomes quite glabrous. On the scape the long hairs occur in particular about its base, and there may be present also the short hairs, so that the scape is pubescent, or it may be nearly glabrous. The bracts, pedicels, and calyx are pubescent; in the forms I am dealing with I find no long hairs upon them. The outside of the corolla is also puberulous more or less.

Keeping this before us as the type of *P. obconica*, Hance, growing in the gorges of the Yangtze as it passes through Hupeh, let us now look at the Himalayan plant *P. Listeri*, King.

This plant (Plate XXVI) was discovered by Mr. J. L. Lister at an elevation of 9000 feet on the south-west side of Tonglloo, South-Western Sikkim, on 7th May 1877. To it Sir George King attached the name of the discoverer, and the description of the species was published by Sir Joseph Hooker¹ in 1882.

¹ Hook. f., in Flor. Brit. Ind., iii (1882), 485. "*Primula Listeri*, King MS.; pubescent, not mealy, rootstock woody, leaves 1-1½ in., orbicular-cordate sinuate-lobed, entire or denticulate, very membranous, petiole equalling the blade or longer, very slender, scapes shorter than the petiole, few-fld., bracts few, linear, calyx campanulate, lobes broad short, corolla rose-pink, tube funnel-shaped, mouth not annulate.

"Sikkim Himalaya; Tonglo and the Singalelah ranges, in bamboo jungles, alt. 9-10,000 ft.

"I retain the species as distinct from *P. filipes* with great doubt, having very imperfect specimens of this last; it differs chiefly in the more orbicular lobulate leaves, broader calyx, and much shorter, more funnel-shaped corolla-tube. Petiole with a very short small sheath,

The plant (Plate XXVII) was found again on 17th May 1881 by Sir George Watt at an elevation of 10,000 feet on the outer spur of Sandukfu in Southern Sikkim (Watt, No. 5307). Sir George Watt gave it the field name of *P. Robertsoniana*, Watt, "intended to indicate the peculiar smell being identical with that of *Geranium Robertsonianum*." This character of odour deserves attention because no collector speaks of a similar odour as marking any plant of true *P. obconicu*, Hance.

The Sikkim *P. Listeri*, King, is a small, more or less pubescent and glabrescent multicapital perennial clothed all over with long thin white hairs, and it has a woody rooting rhizome. From the crown proceeds a cluster of petiolate leaves—some with long vaginate petioles, others with shorter ones—of which the lamina may be described in general terms as ivy-like. Its shape is of that type. Cordate at base with the lobes overlapping, it spreads out in a rotundate or orbicular fashion and becomes five to seven lobed; each of the lobes is more or less denticulate. The scapes, more or less fragile, several of which arise in the leaf cluster, are short—shorter than, or equalling in length, the petioles and therefore immersed in the leaves,—and each bears an umbel of two to four flowers which open successively. The pedicels are quite short—a centimeter or less long—and are sometimes deflexed so that the flower becomes half nodding. Each flower has a cup-bell-shaped calyx with conspicuous broad triangular lobes a third as long as the tube. The corolla-tube is stout and little longer than the calyx, or twice its length, and has no annulus. The small limb has a spread of about one centimeter, its lobe being obcordate and emarginate. In fruit the calyx is accrescent to twice the flowering size, and the capsule is quite flat on top.

The vestiture of hairs: the petioles are clad not densely with long white hairs but are glabrescent. The lamina on the under side, which is slightly paler than the upper side, is glabrous, having as a rule neither long hairs on the veins nor short hairs over the rest of the surface, but there may be some few hairs on the veins. On the other corolla-tube outside, and mouth pubescent. Whole plant smelling like *Geranium Robertsonianum* (Watt)."

hand, the upper surface is pubescent and is not glabrescent. The scape, like the petioles, hairy at first, may become nearly bare of hairs. The bracts, pedicels, and calyx are always puberulous and have no long hairs or may be clad with them; the outer surface of the corolla-tube is faintly puberulous.

Compare now the figures of the Central Chinese *P. obconica*, Hance, in Plates XXI, XXII, XXIII, with those of the Sikkim *P. Listeri*, King, in Plates XXVI and XXVII, and note the differences between them. Yet distinct in aspect though the plants are—and the scent character in *P. Listeri*, King, points to anatomical and physiological differences also—every one of the external differential characters appears in various blendings in a series of intermediate forms, some of which also show isolated variations in directions not foreshadowed in the types from the extremes of the geographical area. To what extent nomenclature is to be called in to designate the intermediate forms is a question that individual botanists will settle for themselves. Already several of the forms have been described as species and named accordingly. That procedure has advantages, particularly in forms of horticultural value, provided that the relations to the external moulding factors are made clear, and the forms are recognised as “microforms”—the term of presentation of the “variety” of the older botanists.

Hance was not happy in placing his *P. obconica*, Hance, as an ally of *P. sinensis*, Lindl., *P. cortusoides*, Linn., and *P. Kaufmanniana*, Regel. To the section “Sinensis” in its widest sense *P. obconica*, Hance, may be referred if you will, but not one of the species named by Hance suggests a likeness.

Sir Joseph Hooker was the first to recognise the real affinity. Writing in the Botanical Magazine in September 1881 under t. 6582—which gives a figure of *P. poculiformis*, Hook. f., the name by which Hooker designated the plant raised by Messrs. Veitch from Maries’ seeds of the Ichang plant described in August 1880 by Hance as *P. obconica*, Hance—Hooker says the Himalayan *P. filipes*, Watt, “is very nearly allied to *P. poculiformis*,

Hook. f., in both habit and form of leaves, calyx, and corolla, but is very much smaller in all its parts, with filiform petioles and scapes and more rounded leaves." And in the following year in *Flor. Brit. Ind.*, iii (1882), p. 485, under *P. filipes*, Watt, he says: "Allied to the Chinese *P. obconica*, Hance (*P. poculiformis*, Hook. f., *Bot. Mag.*, t. 6582), but much smaller and more delicate, and the corolla tube is longer"; and then under *P. Listeri*, King, we find: "I retain this species as distinct from *P. filipes*, Watt, with great doubt, having very imperfect specimens of this last; it differs chiefly in the more orbicular lobulate leaves, broader calyx, and much shorter, more funnel-shaped corolla-tube."

I may say here that the leaf-shape, calyx, and corolla characters used by Hooker as diagnostic are those that are useful in the whole type.

The near relationship of *P. obconica*, Hance, and *P. Listeri*, King, was noted independently by Sir George Watt. In one of the suggestive field notes attached to his herbarium specimens, Sir George Watt says of *P. Listeri*, King (No. 7105 from Manipur), to which he at the time gave the name *P. Robertiana*, Watt: "This is the plant collected by me at Tongloo in Sikkim, sent to Kew. Dr. King informs me it was gathered by Lister there also. It is nearest of all to *P. filipes*, mihi, gathered by Griffith in Bhotan, but I think it advisable to keep it distinct. It is much more robust, and whereas the leaves of *filipes* are oblong, slightly cordate, those of *Robertiana* are rotund-lobed or angled and deeply cordate. *Filipes* is also very much more hairy, but being in an imperfect condition and the figures made by Griffith exceedingly rude, I think it advisable to keep my present plant distinct so as to avoid adding characters to *filipes* gathered from my present material that future research might prove only confused both species. It is also nearly related to *P. poculiformis*, Hook. f. (*P. obconica*, Hance), in *Bot. Mag.*, n. 6582, but differs in the shorter scape which in *Robertiana* is shorter than the leaves, in the larger coarser calyx, and deeper more rounded sinus in the petals. The leaf of *P. poculiformis* is also more ovate oblong, much larger and broader, and the calyx teeth much shorter. I

have nowhere in connection with *P. filipes*, *P. poculiformis*, or *P. Clarkei*, found any reference to the peculiar strong and oppressive odour of this plant, which is identical with that of *Geranium Robertianum* — hence the suggestion regarding the name given above."

Franchet, who next dealt with *P. obconica*, Hance, as a species,¹ comments upon its variableness. "Its different forms," he says, "could be easily taken for distinct species." Of the forms in the Paris Herbarium he diagnosed, however, only three varieties, namely:—

(a) *HISPIDA*.—Pubes dimorpha, ex parte pilis brevissimis, ex parte pilis articulatis elongatis, praesertim in parte inferiore pedunculi et in petiolis, constans; folia ambitu ovata, nunc grosse serrata, nunc angulata, nunc obscure repando-dentata.

Moupin, at the base of rocks, David, February 1869.

Sutchuen, on the bank of the Blue River at Che-pa-to, Delavay, No. 317 bis, 18th April 1882.

Sutchuen, Kou-i-tcheou, Simon.

Hupei, about Ichang, Watters; Delavay, No. 317.

(b) *ROTUNDIFOLIA*.—Pubescentia ut in var. (a); sed folia ambitu rotundata, limbo saepius parvo; flores fere duplo minores quam in varietate praecedente, tubo gracili.

Yunnan, gorge of Pee-cha-ho at Mo-so-yn near Lankong, Delavay, No. 307, 3rd March 1883.

Yunnan, gorges of Lankien-ho, alt. 7400 ft., Delavay, No. 845.

(c) *GLABRESCENS*.—Pubescentia pilis brevissimis constans, exclusis pilis articulatis elongatis; folia ovata vel ovato-rotundata, pallide virentia, grosse crenata vel acute angulata; corollae sat parvae; tubus gracilis ut in varietate (b).

Yunnan, rocks of Tsang-chan, above Tali, Delavay, No. 307, 31st March 1883.

Subsequently, in 1888, Franchet recognised the near relationship of *P. obconica*, Hance, to the Indian *P. Listeri*, King, and in a paragraph upon *P. Listeri*, King, he says:² "It is to this species, very slightly distinct from *P. obconica*, Hance, by its smaller, almost orbicular leaves, angularly sinuate at the margins and sparingly or shortly pubescent,

¹ In Bull. Soc. Bot. France, xxxiii (1886), 66.

² In Bull. Soc. Bot. France, xxxv (1888), 428.

that we must refer the varieties (b) *rotundifolia* and (c) *glabrescens* of *P. obconica*, Hance, to which I have drawn attention.¹ One finds besides forms of transition between the plant of Hance and that of King, which raise doubt of their specific dissociation. Amongst the many specimens from Yunnan which are in the Paris Herbarium, some resemble absolutely the Manipur type described by King; amongst others the leaves are larger and tend to the oval form, the villousness increases, and the hairs become longer, in a fashion making it difficult to separate *P. Listeri*, King, from *P. obconica*, Hance. The calyx and corolla are almost identical in the two plants."

I have made some effort to arrive at a clear interpretation of Franchet's views as expressed in the preceding paragraphs. The words seem to imply this:—

1. There are two species — *P. obconica*, Hance, and *P. Listeri*, King, which are with difficulty separable.

2. *P. obconica*, Hance, var. (a) *hispidula*, Franch., is to be referred to *P. obconica*, Hance.

3. *P. obconica*, Hance, var. (b) *rotundifolia*, Franch., and var. (c) *glabrescens*, Franch., are to be referred to *P. Listeri*, King.

Franchet does not say definitely whether in his view these varieties should be maintained as such under the respective species. The issue is:—

Did Franchet look upon the relationships ultimately as justifying the following grouping:

P. obconica, Hance,
var. *hispidula*, Franch. ;
P. Listeri, King,
var. *rotundifolia*, Franch. ;
var. *glabrescens*, Franch. ;

or

Did he by his latest utterance on the subject in 1888 intend to indicate that he wished to suppress the varietal designations which in 1886 he had put forward for forms of *P. obconica*, Hance, and that to him there were but two forms worthy of naming in the whole alliance, namely:—

P. obconica, Hance, in which the var. *hispidula*, Franch., merges ;

¹ In Bull. Soc. Bot. France, xxxiii (1886), 66.

P. Listeri, King, in which the vars. *rotundifolia*, Franch., and *glabrescens*, Franch., are absorbed.

Pax¹ adopted the latter alternative and introduced *P. Listeri*, King, definitely as a member of the Yunnan Flora, keeping it distinct from *P. obconica*, Hance, and including in it, but not as varieties, Franchet's var. *rotundifolia* and *glabrescens*. Franchet's var. *hispida* he ignores.

George Forrest² took a similar line when describing the primulas collected by him in Yunnan during his first exploration (1904-6) for Bees, Ltd., placing one set of specimens in *P. obconica*, Hance, and another in *P. Listeri*, King.

French botanists after Franchet, who have dealt with primulas—Petitmengin and Bonati—have rather worked in the segregation mood of the first of the foregoing alternatives, going even further than is expressed there by raising one of Franchet's varieties to specific rank, and naming as species others of the forms which Franchet said "could be easily taken for distinct species."

I imagine the real position is that, at the time of his writing, Franchet, overwhelmed by the multitude of novelties which the work of the French missionaries in the virgin area of the rich West Chinese temperate flora poured so bountifully upon him, could only skim the surface of the inflow, and, having no time for critical microform investigation, contented himself with pointing out some broad features that appeared in this variable type. Moreover, I am disposed to suggest that possibly Franchet—as I can assert of the later French botanists—had not adequate material to enable him to form a true concept of *P. Listeri*, King. In any case I cannot accept Franchet's statements as intended to give critical diagnoses within this variable series of forms, and an examination of some of the type-specimens which he cites confirms me in what I say. In subsequent pages I refer to this in some detail—and the point is of importance, having in view confusions introduced by the naming of one of his varieties as a species. Here I may state in brief:—

Under var. (*a*) *hispida* Franchet cites five types:—

¹ Pax in Engler's Pflanzenr. Primul. (1905), 24.

² Forrest in Notes Roy. Bot. Gard., Edin., iv (1908), 216.

1. Delavay, No. 317 *bis*. This is typical *P. obconica*, Hance. See p. 303 and Plate XXIII.
2. A specimen collected "about Ichang" by Watters. The same collector and same locality as for Hance's type *P. obconica*, Hance. See p. 303 and Plate XXI. Presumably the specimens are alike, but I have not seen a Paris sheet.
3. Delavay, No. 317. See p. 322 and Plate XXXV. A truly hispid form, as is also
4. Specimen collected by David in Moupin. See p. 323 and Plate XXXVI. Both of these have also lobed leaves and are not quite typical *P. obconica*, Hance, but are nearer the form of it, which gave us the name *P. poculiformis*, Hook. f.
5. Specimen collected at Kouï-Tcheou by Simon. I have not seen this.

The specimens I have photographed give us an idea of what Franchet meant by his var. *hispidula*—really two forms of *P. obconica*, Hance.

Under var. (*b*) *rotundifolia* Franchet cites two types:—

1. Delavay, No. 307; 3, iii, 83. Lankong. See p. 333 and Plate L.
2. Delavay, No. 845. Lankong. See p. 333 and Plate LI.

These remind one of *P. sinolisteri*, Balf. fil., in their form, but differ from it in vestiture. They are not *P. Listeri*, King. Before saying more about these let me add that—

Under var. (*c*) *glabrescens* Franchet cites one type:—

Delavay, No. 307; 31, iii, 87. Tsang-chan. This type I have not seen from the Paris Herbarium, but at Kew there is one gifted by Paris and named var. *glabrescens*. I have examined it and find that it exactly matches Delavay, No. 845.

Note then that Delavay's No. 307 includes both var. (*b*) and var. (*c*) of Franchet. Under the same number I have also a Paris sheet with a plant which exactly matches Delavay, No. 317. There has been some mixing of forms therefore. But apart from this I also note that neither the Lankong nor Tsang-chan specimens (Delavay, No. 307) correspond with Franchet's description of his var.

glabrescens. Both have plenty of long articulate hairs. At the same time they conform with the picture created by Franchet's description of var. *rotundifolia*.

So far as specimens are concerned Franchet's var. *glabrescens* is not forthcoming. But his description is clear enough. It does not refer to any of the forms that I have seen from the Paris Herbarium. I wish it were otherwise, because I am almost convinced that Franchet's variety is the plant hereafter named *P. sinolisteri*, Balf. fil.

Since Franchet wrote we have come to know many additional forms of this series, some of which may fairly claim to be deserving of distinctive names.

The aggregate *obconico-Listeri* impresses me as a type showing at one extreme a xeromorphous rupestral calcicolous form in *P. obconica*, Hance; at the other a hygrophilous sylvestral one in *P. Listeri*, King; and this interpretation seems to be borne out by the few statements of exact habitat which one finds attached to herbarium specimens by collectors as well as by records in published descriptions:—limestone cliffs—rocky pastures—and the like in the former case; bamboo jungles—damp shady places in the latter. But there are evident gradations of form in relation to variation in intensity of individual factors in the habitat.

Before proceeding to enumerate such forms within the aggregate as will serve to show the directions of variation and the links binding the extremes, I give in summarised form the leading characters of the composite picture in the aggregate so far as these may be derived from an examination of herbarium material supplementing knowledge derived from two forms in cultivation.

Stem-system.—A plant with a stem-system varying from woody rhizome shooting profusely or sparsely from its surface to a short subterranean crown with a profuse evolution of roots.

Foliage.—The leaves always petio'ate and always cordate at the base, the lamina orbicular or rotundate or broadly elliptic, varying in size from $1\frac{1}{2}$ to 15 cm. long, and from 2 to 8 cm. broad, the

margin varying undulate through crenate to acutely lobed, always more or less denticulate, the petiole usually longer—even twice as long as,—sometimes shorter than the lamina.

Clothing of foliage.—Petioles densely villous with brown articulate hairs varying to quite glabrous. Lamina the upper surface pubescent in the adult state to quite glabrous; the lower surface always paler and varying from pubescent with veins clothed with long hairs to entirely glabrous. Margin varying from ciliate to naked.

Scape.—As much as three times the length of the foliage or very much shorter and entirely immersed in it. Villous, pubescent, or glabrous.

Bracts.—Small linear short or large leafy and forming an involucre. Villous, pubescent, or glabrous.

Umbel.—Eight-flowered to two-flowered, always with the flowers opening successively and showing unequal pedicels.

Pedicels.—As much as 2 cm. long, sometimes almost absent. Stout to filiform. Strict or deflexed. Villous, pubescent, or glabrous.

Flower.¹—Size variable.

Calyx.—Campanulate to cup-shaped. Usually much shorter than the corolla-tube, sometimes longer. Barbate, pubescent, or glabrous. Lobes triangular mucronulate, or represented by little more than a slight undulation of the calyx-tube, or broad and denticulate.

Corolla-tube.—Wide or narrow. Sometimes three times the length of, at other times not so long as the calyx. Annulate or exannulate. Pubescent or glabrous.

Corolla-limb.—Limb large with broad lobes, or small with narrow lobes.

Androecium.—There are evident variations in relative position of insertion of stamens and length of

¹ I may note here that dried material in the herbarium is an unsafe index to the flower size in some species of primula. In *P. membranifolia*, Franch., for example, the flower at first expansion is small, though ready for pollination, and it gradually enlarges and reaches full size several days afterwards, when it is three times its original dimensions.

style in both long-styled and short-styled flowers. But I have not had flowers for dissection enough to warrant a definite statement.

Gynaeceum.—What I have said in the previous paragraph is applicable here also. The dimensions of the stigma vary much, and whilst in some forms the dried stigma is red, we know that in *P. obconica*, Hance, in cultivation it is a yellow-green.

Fruit.—Here, again, too few specimens have been available for examination.

In determining the sequence in which to deal with the forms about which I am about to write, I had to consider the possibility of a morphological or an oecological system. Both alike present difficulties born of imperfection of data—sparseness of record on the one hand, fewness of examples on the other. I have therefore neglected both, and shall describe in the first instance variations that clearly approach *P. Listeri*, King, and then variations that may be regarded as more near *P. obconica*, Hance. The series of illustrations should enable anyone to grasp the main points that are distinctive of the several forms.

P. Listeri, King, *P. austrolisteri*, Balf. fil.
(Plates XXVI, XXVII, XXVIII, XXIX, XXX.)

Taking the account of *P. Listeri*, King, in its type form from Sikkim (see Plates XXVI and XXVII) as a starting point, we find variations even in the few specimens that are known to us under the name from other areas.

Plate XXVIII shows a Chumbi plant collected 28th May 1884 by one of King's collectors at Soo-li-la (No. 599). It is not far removed from the Sikkim type, but the specimens give one the impression of a more fragile plant in the foliage, and also markedly in the flower-pedicels, which are longer. We have no indication of its habitat, and I note it mainly as an illustration of slight modification occurring in an area not far removed from that in which the type *P. Listeri*, King, was found, and also because in the lengthening of the pedicels it brings the Sikkim *P. Listeri*, King, towards the plant I shall now speak of.

More prominent are the variations which appear in a

series of specimens collected by Sir George Watt in Manipur and in Assam.

I have before me two sets of Manipur specimens—No. 6561, 18th April 1882, Ching Sow, altitude 8000 feet (Plate XXIX), and No. 7105, 15th May 1882, Japvo, altitude 9500 feet; and one set of Assam specimens—No. 11,746, gathered at Konoma on the Naga Hills in May 1895 at an altitude of 7-8000 feet (Plate XXX).

Sir George Watt indicates on the label of his specimens that the Manipur plants have the odour characteristic of *P. Listeri*, King. He says nothing about this, however, on the tickets of the Assam ones, and on none of the specimens is there indication of the exact habitat of the plant.

The near kinship of these Manipur and Assam plants to the Sikkim *P. Listeri*, King, is clear, but they are not quite the same. Plates XXIX and XXX show the Manipur and Assam plants, and if these be compared with plates XXVI and XXVII of the Sikkim plant, likeness and unlikeness will be readily observable.

The Manipur and Assam plants, particularly the latter, are larger. Their leaves have not so markedly the ivy-shape as have those of the Sikkim plant. Their petioles are longer, the lamina is broader, and the basal sinus wider—this particularly in the Assam plant. Then their scapes are not so robust, though they are much longer, and they tend to become deflexed. Perhaps the most prominent feature of difference on first examination is their delicate flower-pedicel and its length. Along with this goes the greater size of their bracts, which are also broader. Their calyx is more robust and has more rounded lobes; their corolla also is larger.

The Manipur and Assam plants suggest a habitat amongst loose vegetable débris.

Closer examination of the Manipur and of the Assam specimens brings out a difference between them—a difference, however, which does not appear clearly in the half-tone plates. The Manipur plants are essentially glabrous; there is a certain amount of pubescence or puberulousness on the upper surface of the leaves, on the pedicels, and on the petioles, but the under surface of the leaves is quite

glabrous and there is a general want of long articulated hairs upon the plant. Occasionally there may be an indication of these long hairs, particularly at the base of the umbels and of the calyx. The Assam plants are larger and they have more prominently all over long articulated hairs. On the under surface of the leaf of the lamina these hairs occur on the veins, and they are particularly prominent below the umbels and at the base of the calyx where they form quite a beard. These differences, however, are not sufficiently prominent to warrant a real diagnosis of forms, and as the Naga Hills may be looked upon as a northern extension of the Manipur highlands, the isolated specimens from the two localities which I have had under examination may be treated for the present as only slight variants within a limited area of one form of *P. Listeri*, King, leaving it to future exploration to determine whether there is actual segregation of the forms in nature. The combined form is, however, I think, deserving of a distinctive name in this series, and its distribution over an area so far south-east of Sikkim—the home of the type *P. Listeri*, King—suggests the name *P. austrolisteri*, Balf. fil., for the microform.

The physiognomic imprint of *P. Listeri*, King, and *P. austrolisteri*, Balf. fil., is distinct from that of *P. obconica*, Hance. The assemblage of characters in foliage, inflorescence, and flower suffices to establish them as a central form of which doubtless many modifications have yet to be discovered.

I now refer to the plant known as

P. filipes, Watt. (Plate XXXI)

Sir Joseph Hooker¹ was doubtful of the distinctness of *P. filipes*, Watt, from *P. Listeri*, King, “having only very imperfect specimens of this last.” I also am in some difficulty, not because of want of specimens of *P. Listeri*, King, but because of the imperfection of material of *P. filipes*, Watt. I have seen enough, however, to enable me to say with certainty that type *P. Listeri*, King, is

¹ Hook. f. in Fl. Brit. Ind., iii (1882), 485.

different from the type *P. filipes*, Watt, and that they cannot be included under one name.

P. filipes, Watt,¹ is a Bhutan plant, known only from Griffith's specimens (Plate XXXI).² The director of Kew has kindly allowed me to photograph the sheet which is in Kew Herbarium. It is a multicapital rhizomatous plant with slender thread-like petioles carrying thin membranous laminae which are ovate oblong or orbicular and entire or slightly lobed. The plant is more or less pubescent, but has apparently no long articulate hairs. The scape is also slender, quite short, shorter than the foliage, and bears a many-flowered (up to 10) umbel with minute linear bracts and flowers on filiform pedicels 1-3 cm. long. The calyx is very small—only 2 mm. long—and the lobes are very short.

The habitat given by Griffith and cited by all writers is Bhutan, on rocks near Chuka, alt. 6500 feet. I assume it occurs on moist ledges—the foliage is against its being a true rupestral.

Unquestionably in its delicate growth-form, its short inflorescences, and delicate flower-pedicels, *P. filipes*, Watt, recalls features of *P. Listeri*, King, but the two species are diagnosed at once by the form of foliage, which in *P. filipes*, Watt, is usually entire and ovate oblong, in any case seems never to be ivy-shaped, by the umbel which is many-flowered in *P. filipes*, Watt, and by the calyx which is quite small in *P. filipes*, Watt.

¹ The following is the description of the species in Flora of British India.—

"*P. filipes*, Watt, in 'Journ. Linn. Soc. Bot.,' med.; sparingly pubescent, not mealy, leaves 1-1½ inch, orbicular ovate or oblong, cordate entire, lobulate or toothed, petiole as long as the blade, very slender, scape shorter than the leaves, 6-8 fld., calyx-lobes short, very broad, corolla flesh-coloured, mouth not annulate, limb flat, capsule globose included, seeds very minute, smooth. Primula, Griff. Itan. Notes, 123, n. 396; Notul., iv, 299; Ic. Pl. Asiat., t. 485, f. 1.

"Bhotan; rocks near Chuka, alt. 6500 feet, Griffith.

"Rootstock elongate, woody. Leaves membranous. Scape about equalling the petiole, slender in flower, thickened in fruit; bracts small, subulate. Calyx broadly campanulate. Corolla-tube ⅓ inch, three times as long as the calyx, funnel-shaped; limb as much broad; lobes obovate, two-lobed. Seeds ⅛ inch, dark brown, obtusely-angled. Allied to the Chinese *P. obconica*, Hance (*P. poculiformis*, Bot. Mag., t. 6582), but much smaller and more delicate, and the corolla-tube is longer."

² The specimen at the left upper corner of plate is turned top downward on the sheet; by looking at it reversed an idea of the growth-form of the plant will be obtained.

Closer inspection of *P. filipes*, Watt, makes one realise that it is much more like in facies the *obconica* than the *Listeri* group in this series. If one compares the example of *P. obconica*, Hance, that is shown on Plate XXII with the figure of *P. filipes*, Watt (Plate XXXI), one could think that by mere reduction in size of parts the *P. obconica*, Hance, form could be reduced to the type of *P. filipes*, Watt; or, again, compare the Plate of *P. filipes*, Watt, with Plate XLV of *P. Petitmengini*, Bonati, and but little imagination is required to picture the formation of a form like *P. filipes*, Watt, by slight modification. It seems to me to be possible that future exploration is more likely to bring to light forms that will unite *P. filipes*, Watt, with true *P. obconica*, Hance, than forms running it into *P. Listeri*, King.

At the present time, *P. filipes*, Watt, stands as a distinct microform in the *obconico-Listeri* alliance, with a greater leaning to *obconica* than to *Listeri*. This is of much interest because it carries the *obconica* strain much further west than it has been supposed to extend and establishes it in the Himalayan area. Chuka in south-west Bhutan is undoubtedly far from the nearest Chinese locality of *P. obconica*, Hance, that has been recorded, but the occurrence of the *obconica* strain in Bhutan suggests that it will yet be found over the intervening area. Pointing in that direction is the fact that we now know of *P. obconica*, Hance, outside China in the region much farther south. In the Calcutta Herbarium is a sheet of specimens (Plate XXXII) collected by Captain Phillimore in the Shan States at 6000 feet. The plant shows itself as one of the *obconica* strain and presents features to some extent intermediate between those of *P. filipes*, Watt, and *P. obconica*, Hance. There is a form of the latter (Plate XLI) to which in particular it exhibits likeness, and I do not find in it sufficient distinctive marks to justify under our present knowledge the giving of a definite name to it. The interest attaching to the plant arises from the occurrence of it—a true *obconica*—in the area west of the Mekong, or it may be even across the Salween, because the exact locality in the Shan States, whence Captain Phillimore's plant came, is not recorded. *P. obconica*, Hance, we know of in forms all

through Yunnan and the nearest Chinese station east of the Mekong and the Shan States is Szemao—not so far away.

The wild plants of *P. obconica*, Hance, from West Hupeh and East Szechwan in Plates XXI, XXII, XXIII have the physiognomy of limestone xerophytes, but they do not show the extreme xeromorphy that the type exhibits. That is seen in the form to which I have given the name

P. parva, Balf. fil.¹ (Plate XXXIII)

No member of the *obconica* line carries on its face more clearly the marks of the habitat than does the one I now mention under the name of *P. parva*, Balf. fil. The specimens of it which I have seen were collected by Mr. Forrest and by the Abbé Maire, and the habitat of rock clefts on limestone given by both collectors is that which the appearance of the plant suggests.

This dwarf plant has a hard woody rhizome and the characteristic grey look of so many limestone plants. The thick leaves are wonderfully uniform in their cordate or rounded shape, although varying in the length of the hirsute petiole. In the smallest plants the leaves form a dense cluster at the end of the rhizome, and the petioles are shorter than the lamina; in other plants the petioles elongate and push out the lamina far from the crown of the rhizome. The plant foliage is indeed a miniature of that of the typical *P. obconica*, Hance. The inflorescence is

¹ *Primula parva*, Balf. fil.

P. obconica, Forrest, in Notes R.B.G., Edin., iv (1908), 216. *Parva* calcicola heliophila glauca. Rhizoma lignosum vestigiis foliorum obtectum. Folia petiolata nunc ad 15 cm. nunc vix 2·5 longa; lamina 3-4·5 cm. longa et lata nonnunquam minor vel major rotundato-orbicularis crassa supra scabriuscula infra pallidior pubescens venis hirsutis margine subtiliter undulato-crenata denticulata basi cordata; petiolus lamina longior ad 9 cm. longus sed saepe brevior, plus minusve pilis articulatis fulvis vestitus. Scapus brevis intra folia immersus 1-4 cm. longus cum bracteis et pedicellis plus minusve hirsutus umbellam 2-5 florum gerens; bracteae 5 mm. longae lineares; pedicelli 2 cm. longi subfiliformes. Calyx 5 mm. longus campanulato-poculiformis pubescens basi barbatus lobis 1 mm. latis mucronulatus puberulis. Corollae tubus 1·1 cm. longus, lobi obcordata emarginati 7·5 mm. longi, 8·5 mm. lati. Stamina in flore longistylis infra medium tubi corollini inserta. Stylus inclusus; stigma rubrum.

Yunnanfu. Dry clefts of limestone rocks. Alt. 7-9000 feet. G. Forrest, No. 312.

Yunnansen. Maire, No. 924. In clefts of rocks on high peaks.

very different. The hirsute scape is always shorter than the leaves, and the few flowers are on long pubescent and hirsute pedicels. The flowers have remarkably large corollas.

P. obconica, Hance. Forms of slight divergence.

The forms shown on Plates XXI, XXII, and XXIII are taken to be the type form of *P. obconica*, Hance; and for the reasons already given, they are the plant as first described by Hance. They come from the area of original find. They are like the cultivated form (as shown in Plates XXIV and XXV), which we assume to be descended from seedlings raised from Maries' plants. But within the Hupeh area the plant shows variation. Plates XXXIV and XXXV show specimens which illustrate this.

Plate XXXIV is one of Dr. Henry's specimens (No. 1312) collected in West Hupeh; I presume somewhere in the vicinity of Ichang, which was his centre. In it the glaucous hue is not seen save on the under side of the leaf; the form of leaf is more oblong, and there is some variety in form in the several plants; the lobing and denticulation become more evident. The flowers, too, are smaller, and the successive expansion within the umbel becomes very evident. The vestiture of hairs is hardly different from what I have described, save that the young scapes have the brown villous hairs.

Plate XXXV shows one of Delavay's specimens (No. 317) in the Paris Herbarium gathered on rocks at the side of the Blue River (Yangtze) at Ichang. In general aspect it resembles Henry's specimen (No. 1312), but the whole plant is densely clad with the long brown hairs—they coat the scapes and bracts and even the base of the pedicels, and form beard-like tufts at the base of the calyx. The uppermost plant in the plate shows foliage in form more like the cultivated plant (Plate XXIV) and the plant from Chepa-to (Plate XXIII), but the foliage generally is more oblong and the leaf-margin more lobed. As in Henry's plant, the under side of the leaf only has a greyish look. These two plants are undoubtedly *P. obconica*, Hance.

The physiognomy of these specimens recalls the plant which Hooker figured (Bot. Mag. (1881), t. 6582) as *P.*

poculiformis, Hook. f., from specimens grown by Messrs. Veitch at Chelsea from Maries' seeds. Hooker says of it: "Probably a very variable plant. The earliest flowering specimens sent by Mr. Veitch were less hairy and had rounded and nearly entire leaves." It would appear then to be likely that Maries collected both the nearly entire leaved form which is now, I think, the dominant one in cultivation, and also the form with more oblong and lobed leaf which is, so far as I know, not so common.

I add also in Plate XXXVI a figure of specimens in the Paris Herbarium collected, in February 1869, by David, on rocks in the Province of Moupin, a region far north of Hupeh. The plant has some resemblance to that shown in Plate XXXV, but the leaves are larger, more oblong, and lobed, and then the plant is densely villous, with long reddish hairs. Why I include specially this figure is that the specimens shown are amongst the type-specimens upon which Franchet founded his variety (*a*) *hispida* of *P. obconica*, Hance. On p. 313 I quoted from Franchet the types of his variety (*a*) *hispida*. Through the courtesy of the Director of the Botanical Department of the Jardin des Plantes, Paris, I had the privilege of examining three of the types named—that collected in Moupin by David, Delavay's No. 317 *bis* from Szechwan, and Delavay's No. 317 from Ichang—and I have figured them in Plates XXXVI, XXIII, and XXXV. The fourth, which I have not seen, from the Paris Herbarium, is a plant collected by Consul Watters about Ichang (see what I say on p. 313), and is therefore probably a portion of the collection which furnished Hance, in the first instance, with material for the description of *P. obconica*. Hance (Plate XXI). They show that Franchet allowed wide latitude to variation in his variety (*a*) *hispida* within *P. obconica*, Hance. I make no apology, therefore, for segregating the type-specimens he included in his *P. obconica*, Hance, var. (*a*) *hispida*. Delavay's No. 317 *bis* I place, as I have already said, in the typical *P. obconica*, Hance, and Watters' specimen I place here also. Delavay's No. 317 and David's Moupin plant alone could merit the designation *hispida*, but the character is hardly diagnostic of a microform.

Hairy though they are, the foregoing are not the most hairy forms of specimens which have come to Europe. Plate XXXVII shows a remarkable plant represented by the single sheet photographed. It is in Kew Herbarium. Hancock collected it under field number 114 on shady limestone precipices at 6600 feet at Mengtz in December 1893. The right-hand specimen shows a normal *obconica* rosette with leaf-petioles, margins of blades and under side densely villous, the hairs being very darkly coloured and the stout hairy scape bearing many flowers on long pedicels, all being very hairy. The specimen on the left I take to be a monster in which the flower-scape has forked, one branch forming an umbel, the other a many-flowered bracteate raceme.

Of many other forms of divergence—great or small—which the type *P. obconica*, Hance, shows, I shall indicate a few which illustrate special features:—

Plate XXXVIII shows a Yunnan plant which differs from the type in the length of the petioles and is also nearly glabrous. The leaves have a more coriaceous consistence than the normal. The long scape has pedicellate flowers. Note also the robust rhizome.

Plate XXXIX is a Szechwan form which, with leaves of about typical size, has the margin of the leaf-lamina broadly crenate or dentate. It has a fair proportion of hairs over the leaves. The umbel is profusely flowered, and the flower itself, with long pedicel, has a stout corolla-tube.

The Yunnan plant shown in Plate XL recalls in many features *P. filipes*, Watt, but it is altogether a larger plant. The short delicate scapes and the few-flowered umbels bearing shortly pedicellate flowers smaller than usual are marked characters. Further particulars observable in the plant are:—

Rhizomatous. Lamina ovate, 5.5 cm. long \times 4.5 cm. wide; somewhat thick; paler below, upper surface glabrous; margin nearly entire only slightly crenate denticulate ciliate. Petiole about equal to lamina, hirsute but not densely. Scape slender curved equalling or barely exceeding leaves; delicately hirsute. Umbel 3-4-flowered; bracts minute linear with pedicels hirsute. Pedicels slender filiform short 7 mm. at most. Flower long-styled. Calyx

small 6 mm. long, lobes short 1 mm. long with hydathode at end pubescent to hirsute—hairs not very long. Corolla-tube 1 cm. long obovate emarginate. Anthers broad. Tip of anther 5 mm. from annulus. Limb from annulus to base of lobes 1 mm. Style reaches annulus only, not exerted.

It is not far removed from the plant figured in Plate XLI, but the flowers are smaller and petioles longer.

Plate XLI gives a picture of a plant with a true *obconica* rosette of leaves, but more densely tufted than in many specimens. I take it to be a plant which grew in a free, loose soil well moistened, and it has in consequence developed a copious mass of brown roots and is not markedly rhizomatous. The copious relatively short scapes confirm this. The whole inflorescence and the calyx are hirsute, and the large flowers, large spotted calyx, and short stout corolla-tube are conspicuous marks. The following are more details of its structure:—

Has a typical *obconica* rosette, without a rhizome, but with a mass of brown roots. The leaves are mid-sized and oval, almost entire or with slight low crenatures. The lamina about equals the petiole—about 5·5 cm. long as a maximum and 4 cm. wide, nearly glabrous above, paler and shortly pubescent below. Petioles have long brown hairs distributed villously. Scape curving up from leaves and longer than them, hirsute. Bracts, pedicels, and calyx brown hirsute. Flower long-styled. Calyx 5 mm. long. Lobes quite shallow, only 1 mm. long—dark coloured and spotted. Corolla-tube 8 mm. long—lobes obovate, bifid somewhat, undulate, about 6 mm. long. Stamens inserted about half way up tube. Style not exerted. Stigma dark, probably red when fresh.

Of much interest is

P. ambita, Balf. fil. (Plate XLII)

Of this plant I have seen two sets of specimens, and for this I am indebted to M. Bonati. As the illustration shows,

¹ *P. ambita*, Balf. fil. Rhizoma lignosum apice multicipitum vestigiis foliorum vetustorum obtectum. Folia petiolata ad 15 cm. longa; lamina ad 6 cm. diam. crassa orbicularis rotundata vel oblongo-rotundata maturitate pagina superiore glabra vel sparsim puberula inferiore

the plant is of the mould of *P. obconica*, Hance, with typically shaped leaves and scapes extending beyond the foliage, but it has marks which make it one of the most distinct of the *obconico-Listeri* series.

Its hard xeromorphous, nearly glabrous, foliage arrests attention at once, but the characters above others that distinguish the plant are the inflorescence and flower. I know of no other species within the affinity of *obconica* in which one finds an inflorescence like it. The two prominent features are the large foliaceous bracts and the second subcapitular form.

The broad ovate-apiculate bracts are many, and form quite an involucre around the flowers, and from this character the specific name has been taken.

The flowers at full expansion have short pedicels hardly or only a little longer than the bracts, and the time interval betwixt the anthesis of successive flowers is, as in most species of the section, distinctly marked, so that in the developing inflorescence there is an admixture of shortly stalked and almost sessile flowers, giving the whole body a somewhat capitular form which is emphasised by the involucroid bracteal sheath. Then the whole inflorescence is deflexed after the fashion that characterises the soldanelloid primulas—and the successively opening flowers become erect as their pedicels elongate. In fruit—judging

pallidiore venisque etiam hirsutis, margine sinuato-undulata late crenata crenis vel lobis plus minusve denticulatis vel crenulatis, basi cordata; petiolus robustus firmus ad 10 cm. longus pilis longis articulatis fulvis vestitus. Scapus folia vix superans omnino pilis fulvis articulatis dense obtectus umbellam subcapitatum congestam subsecundam plurifloram gerens; bracteae foliaceae magnae exteriores 8.5 mm. longae 5 mm. latae ovatae apiculatae, interiores sublanceolatae acuminatae, venulosae cum pedicellis et calyce fulvo-hirsutae involucrium formantes; pedicelli breves inaequales sub anthesi bracteis breviores vel vix longiores sub fructu erecti. Calyx in flore longistylus 9 mm. longus tubus venulosus corollam superans ad tertiam partem fissus, tubo poculiformi, lobis triangulari-acutis ciliatis ad apicem hyathodeo instructis. Corollae tubus 8 mm. longus, annulatus, limbi 1 cm. diam. discus 1 mm. longus, lobi 4 mm. longi 3 mm. lati oblongi vel elliptici retusi mucronulati. Filamenta staminum valida antherarum apicibus ab annulo 2 mm. remotis. Stylus exsertus. Capsula immatura globosa calyce venuloso inclusa.

Yunnan. Lien-hoa-chan near Ta-yao-hien. Coll. Jean Py, 12, iv, 1909. Ducloux, No. 1619. In Herb. Bonati.

Yunnan. Region of Pinchwan. Coll. Jean Py, 1911. Ducloux, No. 6951. In Herb. Paris. Specimen sent to me by M. Bonati.

from the immature specimens I have seen—the pedicels remain erect.

In addition to these characters the calyx shows points of diagnostic value. The tube is long, very hairy, and the whole calyx exceeds in length the corolla-tube. The venation of the calyx is on the lines of the *obconica* form, but is much emphasised. The corolla has a stout tube which is most distinctly annulate. This annulation of the corolla is, as I have already pointed out, a variable character in the series. *P. obconica*, Hance, itself has but a minute fringe of an annulus, green-yellow in colour within the uniformly-tinted eye. Easily seen in the living plant, the annulus is not so readily made out in dried specimens, and it may be that its apparent absence in forms which have been examined for it only in the dried condition may be a consequence of the drying. Here in *P. ambita*, Balf. fil., it is prominent. I note also that the disk of the corolla between the annulus and the base of the lobes is only 1 mm. broad.

We have no information about the habitat of this plant. Its somewhat thick leaves seem to indicate a spot where some form of physiological drought is induced. It looks like a plant of stony ground, probably sun exposed.

I have without hesitation given a name to this microform.

It is characteristic of the *Listeri* type to have scapes shorter than, or only equalling, the foliage. The inflorescence is thus more or less immersed in the leaves. The same feature occurs in the *obconica* series. We have seen it in *P. parva*, Balf. fil., and we shall see it later in forms like *P. barbicalyx*, Wright. It is conspicuous in a number of large-leaved forms of which I give some illustrations.

Plate XLIII represents a plant of Wilson's collecting (No. 4033), now in the Kew Herbarium. Note the largeness and the denticulation of the lamina, which is somewhat thin. Also the delicate few-flowered scape is short. The plant is almost bare of hairs.

In the herbarium of the British Museum is a specimen

collected by Wilson under the same number (4033), of which I think it worth while to introduce a photograph (Plate XLIV), and I am able to do so by the kindness of Dr. Rendle, Keeper of the Botany Department. The specimen shows how, even in the same collecting, differences in the specimens occur. The plant in Plate XLIV has the general aspect of that in Plate XLIII, but the leaves are much more leathery and want the prominent denticulations. Of these large-leaved short-scaped forms a good example is furnished by the plant which has been described as

P. Petitmengini, Bonati.¹ (Plate XLV)

The specimen which is figured in Plate XLV is the type of this species. It is a rhizomatous multicipitate form. The characters that arrest attention are:—The few leaves; the large lamina, which is membranous, nearly entire, and has projecting veins; the long white hairs; the short scape, very delicate; the short membranous bracts; the long thread pedicels, nearly as long as scape; the few flowers in umbel, which as usual open successively and therefore give unequal pedicels; the very small calyx with apiculate lobes; the narrow corolla-tube. It has, as Bonati says, a look of *P. filipes*, Watt, but the plant is

¹ *P. Petitmengini*, Bonati, in Bull. Soc. Bot., France, sér. 4, ix (1909), 466.

"Species perennis, villosa. Folia longe petiolata, petiolis 6–8 cm. longis, lanatis; limbo integro, vel obscure lobato, basi cordato, ovato-oblongo, obtuso, 7–9 cm. longo, 4–7 cm. lato, membranaceo; nervis inferne eminentibus, ciliatis dense pilis longis lanatis. Scapus foliis multo brevior, 3–5 cm., erectus fistulosus. Bractee 2–3 mm. lineatae, obtusae vel acutae. Umbellae simplices, 3–5-florae. Pedicelli graciles, inaequales, 10–25 mm. longi. Calyx infundibuliformis, haud accrescens, 3–5 mm. longus, superficialiter lobatus, lobis triangularibus, acutis. Corolla calyce duplo longior, tubo cylindrico, 1 cm. longo; limbo concavo tubum aequante, 1.5–2 cm. diametiente, lobis 5 profundis, usque ad tertium superiorem in 2 lobulos obtusos fissis. Capsula parva, globosa, calyce inclusa.

"Yunnan: Se-tze-ou-dy, near Pinchwan. Coll. Jean Py, 3, iii, 1907; Ducloux, No. 5326. In Herb. Paris. Flowers, roses. Type in Herb. Bonati, No. 554.

"Plant near *P. filipes*, Watt, from which it differs in its very large leaves with the petioles shorter than the limb, by its few-flowered umbels, the corolla with concave limb and bifid lobes. It has some analogies with *P. Vilmoriniana*, Petitm., but is clearly distinguished by its shorter scapes, by its leaves, its few-flowered inflorescence, and by its much larger flowers."

larger, the petioles are coarser, the corolla three times larger, and there are other differences.

I take this to be a plant growing in an environment such as would be furnished in a limestone grotto.

Again, in the plant which has been described as

P. Vilmoriniana, Petitm.¹ (Plate XLVI)

we have another large-leaved form of *P. obconica*, Hance, with relatively short inflorescences. It is characterised by its densely hairy covering. It has stout scapes which are much longer than the petioles, and the flowers have short pedicels. The nervation of the leaves on the under side is conspicuous, recalling the condition observed in *P. malvacea*, Franch., and its allies. Dry soil is given as the habitat of one of the set of specimens I have seen.

I give these names and descriptions attached to forms of *P. obconica*, Hance, without confidence that they really mark definite microforms. Until more information comes, they may be taken to represent, the one a less hairy the other a more hairy state of the large-leaved short-scaped series of forms within the type.

I pass now to consideration of that most interesting and prospectively valuable microform which has been already referred to as

¹ *P. Vilmoriniana*, Petitm., in Bull. Herb. Boiss., sér. 2, viii (1908), 365.

"Molliter pubescens. Folia petiolata, petiolum 3-7 cm. longum, limbo 8-11 cm. longa, 4-7 cm. lata, late oblongo vel subrotundo-ovata, basi cordata, membranacea, lobulata, obscure dentata. Petiolus laminam subaequans. Scapus (2-3) 15-25 cm. altus, folia longe superans, umbellam simplicem multifloram (21 fl.) gerens. Bractee parvae 4-5 mm. longae, lanceolatae pedicellis multo breviores; calyx parvus (3 mm.), campanulatus, dense hirsutus, breviter et acute 5 dentatus, post anthesin leviter accrescens (5 mm.). Corollae parvae, roseae, 5-7 mm. longae, calycem duplo superantes; limbus planus 5-6 mm. diam., lobi obcordati. Capsula globosa, calyce inclusa.

"Yunnan: Pe-yen-tsin, Prefecture of Tali. Coll. Jean Py, 19, iv, 1906; Ducloux, No. 4588. In Herb. Paris. Flowers, violet. Dry soil."

Yunnan: Pa-la-ouan. Region of high Pinchwan. Coll. Jean Py, 3, v, 1911; Ducloux, No. 6950. In Herb. Paris.

"Is distinguished from *P. obconica*, Hance, of which it has the aspect, by its very large leaves strongly nerved and with the nerves very apparent on the under surface, by its very small flowers (5-6 mm. diam.) in a simple umbel very dense, with rigid pedicels which are velvet-hairy, as well as the calyx which is scarcely accrescent."

P. sinolisteri, Balf. fil.¹ (Plate XLVII)

This is the plant collected by Mr. George Forrest on dry rocky pastureland in the Yang-pi Valley, western slopes of the Tali range, during his first exploration of Yunnan, under the field number 4101, and assigned by him² to *P. Listeri*, King. Upon his herbarium sheet Mr. Forrest went further and named at first his plant *P. obconica*, Hance, var. *glabrescens*, Franch. (see p. 312). In this particular identification I believe that Mr. Forrest was right for a portion of his specimens. That he did not maintain Franchet's varietal name in his published account of his Yunnan primulas was due in part, I think, to the example of Pax (see p. 312), in part to the fact that he associated specimens, collected under the field number 1815, "on moist moss-covered ledges of cliffs, open or shady situations, in the side valleys on the eastern flank of the

¹ *P. sinolisteri*, Balf. fil.

P. obconica, Hance, var. *glabrescens*, Franch., in Bull. Soc. Bot. Fr., xxxiii (1886), 66. (?)

P. Listeri, King, var. *glabrescens*, Franch., in Bull. Soc. Bot. Fr., xxxv (1888), 428. (?)

P. Listeri, Pax, in Engl. Pflanzenr., Primul. (1905), 21, *ex parte*. (?)

P. Listeri, G. Forrest, in Notes Roy. Bot. Gard. Edin., iv (1908), 216, *ex parte*.

Plants saxosa ad 2 dm. alta glaucescens puberula neque hirsuta nec villosa. Rhizoma multicapitum lignosum vestigiis siccis foliorum praeteritorum obtectum. Folia petiolata ad 10 cm. longa; lamina rotundato-orbicularis cordata 2-4 cm. diam. rarius major obtusa lobata lobis acutis vel obtusis denticulatis margine obscure ciliata supra vix puberula subtus pallidior glabra vel venis primariis minute puberulis; petiolus rigidus tenuis puberulus ad 6 cm. longus. Scapus foliis longior vel ea subaequans strictus puberulus umbellam 2-8-floram gerens; bractee lineari-lanceolatae puberulae ad 8 mm. longae submembranaceae; pedicelli stricti divaricati puberuli bracteis longiores ad 1.4 cm. longi. Flores albi vel rosei. Calyx cupularis puberulus submembranaceus 6-7 mm. longus lobis triangularis nonnunquam denticulatis 3 mm. longis apice corneis. In flore longistylis: corollae tubus 7-8 mm. longus vix annulatus, limbi discus 2-5 mm. longus, lobi 7 mm. longi 1 cm. lati; stamina 3 mm. a basi tubi corollae inserta; stylus exsertus; stigma cuboidea rubrum. In flore brevistylis: corollae tubus 1 cm. longus annulo conspicuo infra stamina transverse rugosus, lobi 6 mm. longi, antherarum apices fere exserti; stylus calyce vix brevior; stigma rubrum.

Yunnan: Yang-pi Valley, western slopes of the Tali range. Lat. 26° 30', alt. 7-9000 ft. Coll. Forrest, No. 4101, v, 1906. Plant of 6-8 inches. Flowers white, eye greenish yellow. Fragrant.

² G. Forrest in Notes Roy. Bot. Gard. Edin., iv (1908), 216.

Tali range," which did not quite fit in with the varietal description. However this may have been, Forrest's No. 4101 is, in my belief, the *P. Listeri*, King, var. *glabrescens*, of Franchet's description (see p. 310); Forrest's No. 1815 is a less xeromorphous form probably in consonance with habitat.

To have retained Franchet's varietal name of *glabrescens* for the plant here called *P. sinolisteri*, Balf. fil., would have been following recognised rules, but there is a *P. glabrescens*, Nylander, now sunk in *P. stricta*, Hornem., and a *P. glabrescens*, Arv.-Touvet, said to be a hybrid (*elatior* × *officinulis*), and possibly the same as *P. media*, Petermann, according to Pax. The name selected indicates the Chinese distribution of the plant and the affinity with *P. Listeri*, King.

P. sinolisteri, Balf. fil., is an easily distinguished form in the series *obconico-Listeri*. The woody rhizome is well-developed (see the top left-hand figure in Plate XLVII). The leaves have wiry petioles with a firm vagina and are usually longer than the lamina, which is rounded orbicular with cordate base and sharply marked marginal lobing, the lobes denticulate. In this lobing the leaves show the form so conspicuous in *P. Listeri*, King. The lamina, too, has a firmer consistence than in many other forms, Distinguishing the form at once from all others is the character which gave origin to Franchet's varietal name of *glabrescens*—the absence of long articulate hairs. The petioles, scapes, bracts, pedicels, and calyx are more or less puberulous; the upper surface of the leaf may also be slightly puberulous, but the hirsute or villous covering so evident in all the *obconicas* is absent here. Indeed the plant at sight seems to be glabrous. The scapes are not long, though they exceed in length the foliage. The strict pedicels diverge and the calyx lobes are conspicuously triangular often with denticulations. The difference in length of the corolla-tube in the long-styled and short-styled flowers is very marked, and the former have, as is so common in the type, a better developed annulus and a narrower throat than the latter. The style is exerted in the long-styled flower.

This plant is one of the most pleasing of the introductions

which we owe to Forrest. Of the *obconica* type, it wants the irritant property of *P. obconica*, Hance. In cultivation it forms neat dense tufts of dark green leaves, from amongst which the well-balanced scapes ascend, bearing commonly two tiers of flowers which are typically snow-white. It is not quite hardy about Edinburgh, but I believe it thrives out-of-doors in South England. In greenhouse work it should better *P. obconica*, Hance, and rival perhaps *P. sinensis*, Sabine, and *P. malacoides*, Franch. Grown planted out in a frame it flowers throughout the whole year. In my belief it is a coming horticultural plant. It shows some variation in tint of flower; these are sometimes a pale violet.

A comparison of Plates XXI (*P. obconica*, Hance), XXVI (*P. Listeri*, King), XLVII (*P. sinolisteri*, Balf. fil.), ought, I think, to satisfy anyone of the justness of the claim of *P. sinolisteri*, Balf. fil., to its distinctive name as a microform intermediate to the other two plants which have been given specific rank. It is, however, only a phase of physiognomic development in relation to environment, and, as I am about to show, grades on the one side into less xeromorphous, on the other into more xeromorphous forms.

Of the former, I show in Plate XLVIII an example. This is Forrest's No. 1815, referred to above. The impression given one is of a plant of a moister and shadier habitat such as the record asserts. The rhizome is less rigid and developed, the leaves are larger and more membranous, they have a more oval form, and the lobing is but slightly indicated. The scapes are longer, more erect, and the flowers larger, and some of them have very long corolla-tubes. The calyx has not the prominent triangular segmentation—the lobes are broader and more rounded with a mucro. The whole plant is pubescent, and whilst the older leaves are nearly glabrous, as in *P. sinolisteri*. Balf. fil., the younger ones are hirsute, and there is a tendency to formation of some long hairs at the base of the umbel and of the calyces.

As an illustration of passage to more xeromorphous forms, I give on Plate XLIX a representation of a plant collected about Tseku by Père Monbeig (No. 178), without definite statement of habitat. The aspect of the plant

suggests that it comes from limestone, and indeed it may be regarded as on the way to the form which I have described as *P. parva*, Balf. fil. All the features that give this impression do not come out in the picture—the glaucous hue of the plant for one. The short petioled leaves are here more rounded and cuneate, and long hairs are found on petioles, veins of under surface of leaf, scape, bracts, and pedicels, and there is a beard at base of the calyx. The umbel is few-flowered (2-5). The pedicels are short—under a centimeter long. The calyx has short lobes, often mere undulations at top of tube with some projecting denticules.

In this plant we have the form diagnosed by Franchet as *P. Listeri*, King, var. *rotundifolia*, Franchet. On Plates L and LI are shown two sheets of Franchet's variety for comparison from the Paris Herbarium. I am indebted to M. Lecomte, Director of the Botanical Department, Jardin des Plantes, Paris, for the loan of the sheets, which have been photographed. These sheets bear specimens of Delavay's collecting under No. 307 and No. 845—the specimen cited by Franchet as types of his variety (see p. 313).

I give these illustrations because of some confusion that has been introduced into the identifications, and of this I must now say something.

Petitmengin wrote¹ about a species which he named *P. begoniiformis*, Petitm., and which he founded upon a specimen in the Paris Herbarium having the same ticket as that of the specimen named *P. Listeri*, King, var. (*c*) *glabrescens*, by Franchet. Of his species he says: "Near *P. obconica*, Hance, and *P. Listeri*, King," and only gives the following differential, not determinate diagnosis:—A plant of glabrous aspect covered by very short hairs of which the cell membrane is reticulate, whilst in *P. obconica*, Hance, the plant is velvety and the long hairs have no reticulations on the wall; in *P. Listeri*, King, the hairs are elongated as in *P. obconica*, Hance, and have the same constructions and the same wall pattern as in *P. begoniiformis*, Petitm. It further differs from *P. obconica*, Hance, and *P. Listeri*, King, in having a rhizome, fragile, covered with the im-

¹ Bull. Soc. Sc. de Nancy, sér. 3, viii (1907), 11.

bricate, coriaceous, reddish vaginae of fallen leaves; leaves rhomboidal, inciso-serrate, acute, cordate, with a long sheathing vagina; umbel few flowered (3-6), in *P. Listeri*, King, it is 1-3 flowered, in *P. obconica*, Hance, 9-13 flowered; pedicels more slender; flowers larger; corolla large, with slender white tube and larger limb 2 cm. wide, 1-1.5 cm. long; stamens inserted on a ring at the constriction of the throat; calyx-segments much shorter.

With regard to these characters it is an error to lay stress upon the sculpturing of the hairs as Petitmengin does. All members of the *obconico-Listeri* series may have, as Franchet pointed out, short hairs and long hairs, or the former only. All hairs have the same structure, show the striation to which Petitmengin refers. It is not a differential mark. Also the series have rhizomes with vaginate leaves, and the vaginae remain coating the rhizome. The ring he speaks of at the insertion of the stamens is not a definite structure—the ring effect through corolline constriction over the ovary is seen in all forms in the series.

Through the courtesy of M. Bonati I have been able to examine two specimens of *P. begoniiformis*, Petitm., one from the Paris Herbarium, the other from Petitmengin's Herbarium. Plate LII, A, B, shows these specimens, and I quote here the labels attached to them.

A, the Paris specimen, reads: "*Primula obconica*, Hance, var. *rotundifolia*, Franchet." This has been scored out and "*begoniiformis*, Petitm." substituted in Petitmengin's writing. Then follows "Les gorges de Pee-cha-ho, près de Mo-so-yn, Lankong, Delavay, 27 mars 1887."

The ticket on specimen B reads: "*Primula begoniiformis*, Petitm., in rupibus ad fauces montis Pee-cha-ho prope Lankong, 3 Mart. 1883. Delavay, No. 307. Det. Petitmengin."

These specimens then tell us what Petitmengin meant by his *P. begoniiformis*, but neither of them answers to his description. They both of them have long hairs. Without further criticism they are the *P. Listeri*, King, var. (*b*) *rotundifolia*, Franchet. Specimen B is, in fact, a portion of the same collecting (Delavay's No. 307, Lankong) as the specimen shown in Plate L, one of Franchet's types,

and specimen A was labelled, in the first instance in the Paris Herbarium, with the name given by Franchet, and it comes from the same locality as B. Yet in his description of the species Petitmengin quotes neither of them, but cites the specimen which is the type of Franchet's var. (c) *glabrescens*. The plant so described by Franchet is, as I have already pointed out (see p. 333), *P. sinolisteri*, Balf. fil. The specimen cited by Franchet as the type is Franchet's var. (b) *rotundifolia*. Neither of Petitmengin's specimens of *P. begoniiformis*, Petitm., is *P. sinolisteri*, Balf. fil., nor do the types of Franchet's variety (b) *rotundifolia* belong to *P. sinolisteri*, Balf. fil.

I suspect that the confusion introduced by Petitmengin may be traceable to the fact that under No. 307 of Delavay both Franchet's (b) *rotundifolia* and (c) *glabrescens* are included. However this may be, the question I have to settle for myself here is what nomenclature is to be adopted. Had the name *rotundifolia* been free, using it would have simplified matters, but it is already taken for Royle's beautiful Himalayan plant. The name *P. begoniiformis*, Petitm., might have been suppressed. I have concluded to trust to Petitmengin's actual specimen determinations rather than to his descriptive account and reference to a mixed type, and have therefore retained his name for the microform designated by Franchet (b) *rotundifolia* and shown in Plates XLIX, L, LI, LII.

On Plate LIII is shown a representation of the type-specimen of a species of primula described by R. Knuth under the name *P. Bonatii*, Knuth.¹ I am indebted to M. Bonati for the opportunity of examining and figuring the species. I give here Knuth's description of his species:—

"Perennis, 10-12 cm. alta. Folia paucinumerosa, 4-8; petioli 1½-3 cm. longi, crassiusculi, pilis articulatis glanduligeris±rubellis hirsuti; lamina firma vel fere subcoriacea, ambitu ovata vel ovalis basi±cordata, usque 5 cm. longa et 4 cm. lata, subtus ad nervos subhirsuta, margine vix repando-lobulato. Scapi plures, umbellam unicam congestam gerentes, folia 1½-2½-plo. superantes, usque 10 cm.

¹ *Primula Bonatii*, R. Knuth, in Fedde, Repertorium Novarum Specierum, vol. viii (1910), p. 398.

longi, pilis \pm minutis glandulosis pubescentes. Bractee lanceolatae pubescentes, 5 mm. longae. Pedunculi 2-4, brevissimi, bracteis, breviores. Calyx inflatus, infundibuliformis, pilis minutissimis glandulosis densis puberulus; laciniae latae obtusae vel vix perspicue mucronulatae, 3-4 mm. latae et $1\frac{1}{2}$ -3 mm. longae. Corollae tubus calycem 2-4-plo superans, 2 mm. crassus, pallidus; limbus violaceo-coeruleus; lobi usque ad $\frac{1}{3}$ -partem bilobulati lobulis rotundatis.

"Yunnan, Lao-kouy-chan, near My-le. Coll. Paul Nguéou, 26th April 1908. Type in Herb. Bonati, No. 492.

"Nota.—Species affinis est *P. obovatae* et *P. Listeri*. Ab hac specie differt pedicellis multo brevioribus et foliis crassioribus, ab illa forma foliorum."

Anyone who compares the figure in Plate LIII with those in other plates included in this paper, showing unnamed forms of *P. obconica*, Hance, should be able to satisfy himself that the plant named by Knuth is no species. An analysis of the description fails to bring out any tangible character of differentiation of the specimen from the ordinary forms of *P. obconica*, Hance. When Knuth says "affinis est *P. obovatae*," I presume he means the Chinese *P. obovata* (Hemsl.), Pax. The only other plants that have borne the name are the European *P. obovata*, Huter, a doubtful hybrid (*ciliata* \times *tyrolensis*), and *P. floribunda*, Wall., of which *P. obovata*, Wall., is a synonym. But *P. obovata* (Hemsl.), Pax, belongs to the section *Carolinella* of *Primula*. Not merely leaf-form but flower and fruit characters as well as vestiture separate the *P. obovata* (Hemsl.), Pax, from Knuth's plant. Then when Knuth says "affinis est *P. Listeri*," to what does he refer? To the *P. Listeri* in Franchet's sense, or to the restricted *P. Listeri* of King? From the latter Knuth's plant differs in every way, as comparison of figures attached to this paper shows. To the former it belongs and to the *obconica* section of it. Much shorter pedicels and thicker leaves are insufficient diagnostic marks by which to segregate a form in the *obconico-Listeri* alliance, and the story of the articulate hairs as well as the other points mentioned in the specific description would suit admirably the quite typical form of *P. obconica*, Hance.

Primula Bonatii, Knuth, as a name for a primula must be suppressed.

A form of more character is that which has been described as

P. barbicalyx, C. H. Wright.¹ (Plate LIV)

Here we have a plant from Mengtz in Southern Yunnan, collected by Hancock, under field number 109, on limestone crags at 8700 feet, and also by Henry (No. 10,512) on cliffs at 7000 feet, which belongs to the very hairy forms of the series. It is a dwarf with leaves smaller and lobed a little more prominently than in the form figured in Plate LV, but densely hirsute all over. The scapes are quite short and the inflorescence is therefore buried in the foliage, but the pedicels are long and somewhat filiform. The calyx is distinct—apart from the density of the barbation at its base—in the long and acute lobes at times denticulate. It hardly approaches *P. Listeri*, King, as Wright suggests. It is entirely an *obconica* form and quite a distinct one.

From Szemao I have specimens (Plate LV) of a plant which may be regarded as an enlarged *P. barbicalyx*, C. H. Wright, and more nearly approaching the hispid form of *P. obconica*, Hance. It was collected by Henry (No. 11,999) in mountain forests at 4000 feet. The leaves are larger and have longer petioles than *P. barbicalyx*, C. H. Wright. The scape is longer and carries a truss of shortly pedicellate large flowers. The calyx is particularly noteworthy. It is somewhat membranous with large acute lobes which always have a fringe of white hairs and are,

¹ C. H. Wright in Kew Bulletin (1896), 24. The technical description given by Wright is:—

"Humilis, foliis membranaceis ovatis dentato-sinuatis ciliatis pilosis, petiolo laminae aequilongo dense piloso, pedunculo brevi, floribus 2-5 umbellatim dispositis, pedicellis elongatis, calyce campanulato extus (praesertim basi) pilis brunneo-purpureis vestito lobis 5 triangularibus, corolla dilute lilacina longe tubulosa segmentis 5 bilobatis.

"Habitat.—China: Yunnan, Mengtse, limestone crags at 8700 feet, W. Hancock, 109.

"Folia 1-1½ poll. longa, ¾-1 poll. lata; petioli 1 poll. longi. Pedunculi 1 poll. longi vel breviores; pedicelli 6-9 lin. longi. Calyx 2 lin. longus. Corollae tubus 5 lin. longus; limbus 6-8 lin. diam.

"Resembling *P. Listeri*, King, but differing in having a smaller calyx covered with long brownish-purple hairs and a large corolla."

moreover, sometimes denticulate. It is far more deserving of a name than some to which particular names have been attached. It has special interest because it seems to me to lead us to the plant which Franchet described as

P. oreodoxa, Franch.¹ (Plate LVI)

This is one of the Moupin plants collected by the Abbé David and described and figured by Franchet.

It is true, as Franchet says, that the leaves resemble those of *P. cortusoides*, Linn., but they do not speak to affinity in the way the other characters do, and particularly the calyx. These all seem to point to *P. obconica*, Hance. The toothed sepaline lobes are distinctive—and, with other characters, seem to separate this plant more than others mentioned from the *obconica* type. But in *P. barbicalyx*, C. H. Wright, we have an approach to the calycine lobing, and I think I am right in placing this plant here as a species of the *obconico-Listeri* alliance. I may add here that the *P. oreodoxa* of gardens is not this plant. Sundermann sent out a plant under the name which is often met with, but is only *P. saxatilis*, Komarov. The true *P. oreodoxa*, Franch., is not in cultivation.

With this I conclude the series of illustrations through which I have endeavoured to show some of the forms through which *P. obconica*, Hance, with its centre of distribution in Western China, and *P. Listeri*, King, with its area of spread in the Eastern Himalayas, pass. The record is by no means satisfactory, because I am unable to deal with the plants in relation to habitats. Such as it is, it

¹ Franchet in Nouvs. Arch. du Mus., Paris, sér. 2, x (1887), 55, t. 15, f. B. Franchet's description and comments run:—

"Rhizoma gracile, obliquum; ex toto hirtella; petiolus alato-membranaceus limbo usque duplo longior; limbus pallidus tenuiter papyraceus, fere membranaceus, utraque facie sparse pilosus e basi leviter cordata elliptico-ovatus, apice rotundatus, -profunde crenatus, crenis argute denticulatis; pedunculi folia 2-3-plo superantes; pedicelli 3-7 inaequales, calice subduplo longiores, bracteolis lineari-lanceolatis; calyx e basi cuneata poculiformis, tubo pallidior, ad tertiam partem lobatus, lobis ovatorotundatis denticulatis; corolla rubro-violascens, tubo cylindrico calycem subduplo excedente, in limbum cupulatum expanso, lobis obcordatis; stamina paulo supra medium tubi inserta; capsula globosa intra calycis tubum inclusa.

"Petioli 2-5 cent., limbo 2-5 cent., longo 2-3 cent. lato; pedunculi 6-15 cent.; pedicelli 1-2 cent.; calyx circiter 7 mill.; corolla 10-13 mill. longa, limbo 10-12 mill. diam."

may suffice to suggest to workers in China, Burmah, and East Himalaya a subject requiring investigation, and upon which their observations may throw light.

SUMMARY.

Primula obconica, Hance, has a wide distribution in Eastern Asia, whence it spreads into Burmah and reaches Bhutan.

It is a xeromorph in many of its forms.

In the Eastern Himalaya occurs *P. Listeri*, King—as yet known only from a few localities.

It is mainly a sylvestral in most of its forms.

The type form of *P. obconica*, Hance, is a plant with stalked ovate rotundate entire leaves with scapes longer than the leaves, and bearing single umbels of several flowers.

The type form of *P. Listeri*, King, is a plant with stalked ivy-shaped leaves with scapes shorter than the leaves, and bearing few-flowered single umbels.

Both vary—the former most. The variations appear in all organs of the plants, and link the two types together, perhaps not completely.

Information is as yet insufficient for the correlation of the variations with definite condition. Some of them, however, are so distinct as to deserve definite names as microforms in a widespread aggregate.

The aggregate, which may be called for the time the section *Obconico-Listeri* of *Primula*, includes:—

P. AMBITA, Balf. fil.: an *obconica* which is glabrous and has a large involucre and nearly sessile flowers.

P. AUSTROLISTERI, Balf. fil.: a *Listeri* which has long petiolate leaves and thread-like pedicels to the larger flowers.

P. BARBICALYX, C. H. Wright: an *obconica* with hirsute covering, short scapes, and a calyx bearded at the base, its lobes long and often denticulate.

P. BEGONIIFORMIS, Petitm.: an *obconica* with small leaves, often lobed, and always more or less hairy.

P. Listeri, King, var. *rotundifolia*, Franchet.

P. Listeri, King, var. *glabrescens*, Franchet (*ex specim.*).

P. obconica, Hance, var. *rotundifolia*, Franchet.

P. obconica, Hance, var. *glabrescens*, Franchet
(*ex specim.*).

P. BONATH, Knuth: a nondescript = *P. obconica*, Hance.

P. FILIPES, Watt: a dwarf obconica with delicate petioles,
and scapes shorter than leaves.

P. LISTERI, King.

P. OBCONICA, Hance.

P. obconica, Hance, var. *hispida*, Franch.

P. poculiformis, Hook. f.

P. OREODOXA, Franch.: an obconica, hairy, and with
narrow oblong lobed leaves, and a calyx showing
remarkable denticulate lobes.

P. PARVA, Balf. fil.: a rupestral dwarf glaucous obconica
with stout petioles and scapes shorter than leaves.

P. PETITMENGINI, Bonati: a large-leaved obconica, not
markedly hirsute, with scapes shorter than leaves,
and long pedicels thread-like. Doubtfully distinct
from *P. Vilmoriniana*, Petitm.

P. POCULIFORMIS, Hook. f. = *P. obconica*, Hance.

P. SINOLISTERI, Balf. fil.: a glabrescent obconica with
acute lobed small leaves, and scapes longer than
leaves.

P. Listeri, G. Forrest (*ex parte*).

P. Listeri, King, var. *glabrescens*, Franch. (*ex
descr.*).

P. Listeri, Pax (*ex parte*).

P. obconica, Hance, var. *glabrescens*, Franch.
(*ex descr.*).

P. VILMORINIANA, Petitm.: a hirsute large-leaved ob-
conica with stout scapes shorter than leaves, and
short pedicels.

POSTSCRIPT.

Since the preceding story was told to the members of
the Botanical Society, the Primula Conference of the
Royal Horticultural Society has been held, to which I
contributed an account of Asiatic Primulas, not Himalayan.
Speaking of the *obconico-Listeri* series, I included in it
P. Cavaleri, Petitm., as one of the growth forms. Some
better material than that which I had been able to examine

has recently passed through my hands, and I have come to the opinion, after examination of it, that the species ought not to be included in this section, and no mention of it is therefore to be found in what precedes.

In concluding my comments upon *obconico-Listeri* at the Conference, I said¹ :—

“I have placed on view a series of photographs of forms illustrating the variations rapidly sketched, and I offer the problem involved in this complex section to students of variation.

“This variability in nature of the *obconica* type is from the outlook of Botany a problem of some interest, because in the thirty years during which the Ichang plant has been in cultivation there has not been the varietal progression one would expect, even after allowing for the handicap of its evil repute as an irritant; whilst *P. sinensis*, Lindl., a plant also of the limestone rocks at Ichang, of which in nature we have no record of variation—no wild forms spread over an area outside its limited home on the Yangtze—is in cultivation profuse, as we all know, in the wonderful outshoots of vegetative and flower character it makes. That there is a difference of constitution between the plants growing side by side in native habitat must have been recognised long ago by the Chinese, who have made much of *P. sinensis*, Lindl., but not of *P. obconica*, Hance, and our experience in Europe confirms Chinese empiricism. What we have to find out now is wherein is the essential difference in the species. It is opportune to present for investigation a case like this of two co-habiting species, attractive as they grow in nature, of cultural value, not distant in consanguinity, which outwardly present equally valid characters of adaptation, yet the one variable and consequently spreading in nature over a wide area, but resistant in cultivation; the other so little variable in nature as to have a restricted boundary of distribution, and yet in cultivation the parent of innumerable varieties which are amongst the glories of horticultural skill. It is no simple problem, the factors involved are many, but the starting-point is admirably clear and definite in the two wild plants growing together on the same range of rocks.”

¹ See Report of Primula Conference, 1913, p. 143.

This has brought to me a criticism from Mr. E. H. Wilson, the renowned traveller and collector. He says: "Your information as to the habitat of *Primula obconica* is scarcely accurate. As far as my knowledge goes, this plant is always found in moist grassy places. It is abundant around Ichang by the wayside. Unlike *Primula sinensis* it never occurs on the face of cliffs or in dry rocky places."

This is a valuable comment. It tells that what we have considered the type form of *P. obconica*, Hance, is not a chasmophyte, and at Ichang whence it and *P. sinensis*, Lindl., are found, the habitats of the two species are not alike. This does not detract from the interest to the problem I have formulated—increases it rather, because we learn from the notes of collectors, and no less from the physiognomy of the specimens preserved, that *P. obconica*, Hance, may become a chasmophyte—*P. parva*, Balf. fil., for instance, from clefts of rocks on high peaks, carries the impress of its rupestral environment. I gather that *P. sinensis*, Lindl., is chasmophilous and restrictedly so, whilst *P. obconica*, Hance, has the capacity of chasmophily, although at Ichang it does not exercise its powers in this way. Why? Is it a question of altitude or of nature of rock?

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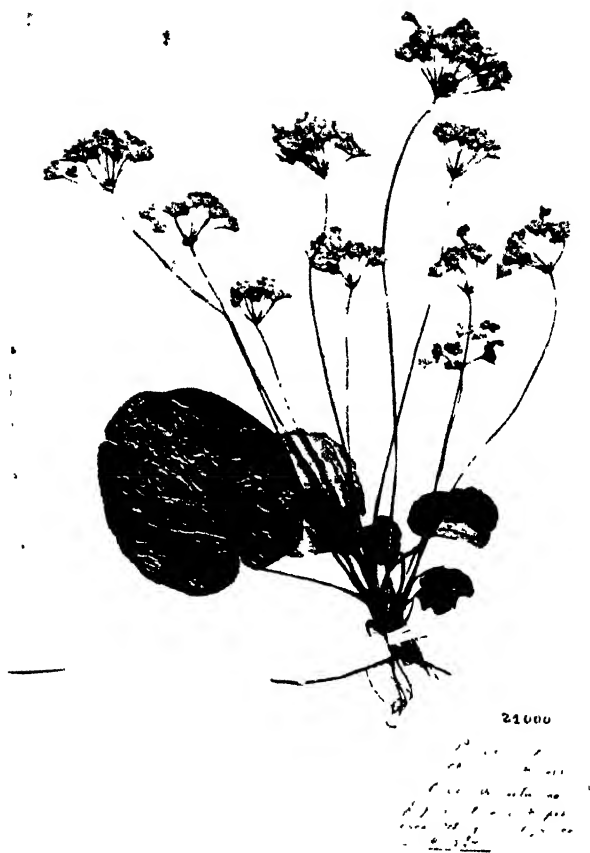
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- XLIX. *Primula begoniiformis*, Petitm. Yunnan. Coll. Mombeig, 1907. No. 178. In Herb. Edin.

Plate.

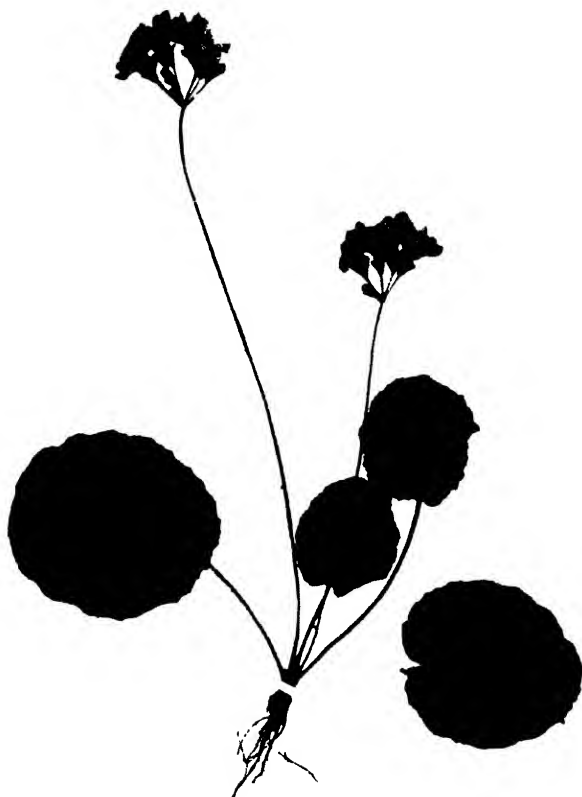
- L. *Primula begoniiformis*, Petitm. Yunnan: Lankong, gorge of Pee-cha-ho at Mo-so-yun. Coll. Delavay. No. 307. 3, iii, 1883. In Herb. Paris.
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- LIIA. *Primula begoniiformis*, Petitm. Yunnan: Lankong, Pee-cha-ho, near Mo-so-yun. Coll. Delavay. 27, iii, 1885. Flowers violet red. In Herb. Paris.
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- LIIL. *Primula Bonatii*, Knuth. Yunnan: Lao-kouy-chan, near My-le. Coll. Nguéou. Ducloux. No. 885. 26, iv, 1908. In Herb. Edin.
- LIV. *Primula barbicalyx*, C. H. Wright. Yunnan: Mengtz, N. Mountains, 7000 ft. On cliffs. Coll. Henry. No. 10,512. Flowers pinkish. In Herb. Edin.
- LV. *Primula barbicalyx*, C. H. Wright. Yunnan: Szemao. Mountain forests, 4000 ft. Coll. Henry. No. 11,999. Flowers pale purple. In Herb. Edin.
- LVI. *Primula oreodora*, Franch. Yunnan: Moupin. Cold mountains. Coll. David, April 1869. Flowers red. In Herb. Paris.

The photographs for Plates XXI and XLIV were procured for me by Dr. Rendle, Keeper of the Botany Department, British Museum. All the other photographs were taken by Mr. Robert Moves Adam, Assistant in the studio of the Royal Botanic Garden, Edinburgh.

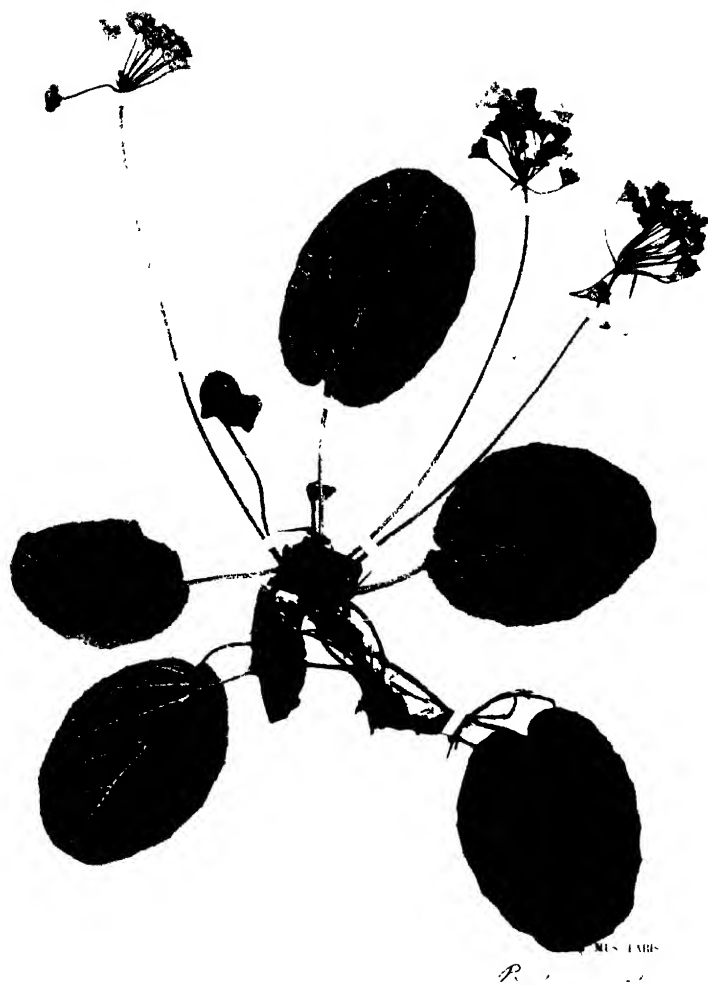
(Issued separately Nov. 30, 1914.)



Primula obconica, Hance. Type in Herb. Brit. Mus.



Primula obconica, Hance In Herb. Edin.



Primula obconica, Hance. In Herb. Paris.



1811-1812, 1813, 1814

Primula obconica

Hort. Edin. 26 p. 1813

Primula obconica, Hance. Spec. cult. In Herb. Edin.

Professor BAYLEY BALFOUR.



PL. XXV.
Primula obconica
 H. B. K. 20. VI. 1847

Primula obconica, Hance. Spec. cult. In Herb. Edin.

PROFESSOR BAYLEY BALFOUR.

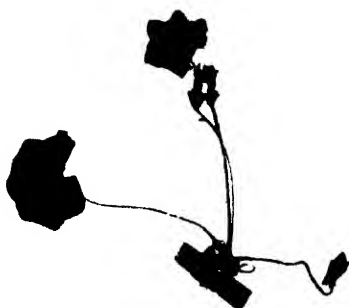


Pl. 1. 5. 11. 11.

11. 11. 11.

11. 11.

Primula Listeri, King. Type in Herb. Calcutt.



of *Prima Listeri* (King) in Herb. Calcutt.

Pl. in 1911

No. 597

Hab. *See - 6 - 6*

at.

Date 26. 5. 1881. Dr. King. Herbar.

Prima Listeri

26. 5.

Prima Listeri, King. In Herb. Calcutt.

Professor BAYLEY BALFOUR.

*Primula
robusta* Watt



FLORA OF MANIPUR

How's Primula best?
Buxton, a. Watt

Primula austrolisteri, Balf.

No. 1211

Cherry Sea

12. 10. 1902

COLLECTED

During the Government Examination Survey of 1901-02.

D. CLARK WATT

Primula austrolisteri, Balf. fil. In Herb. Edin.

PROFESSOR BAYLEY BALFOUR.



P. austrolisteri, Balf. f.

Date . . . 188 . . .
Locality . . . Alt . . .

Primula Listeri Henry

Field No. 11746

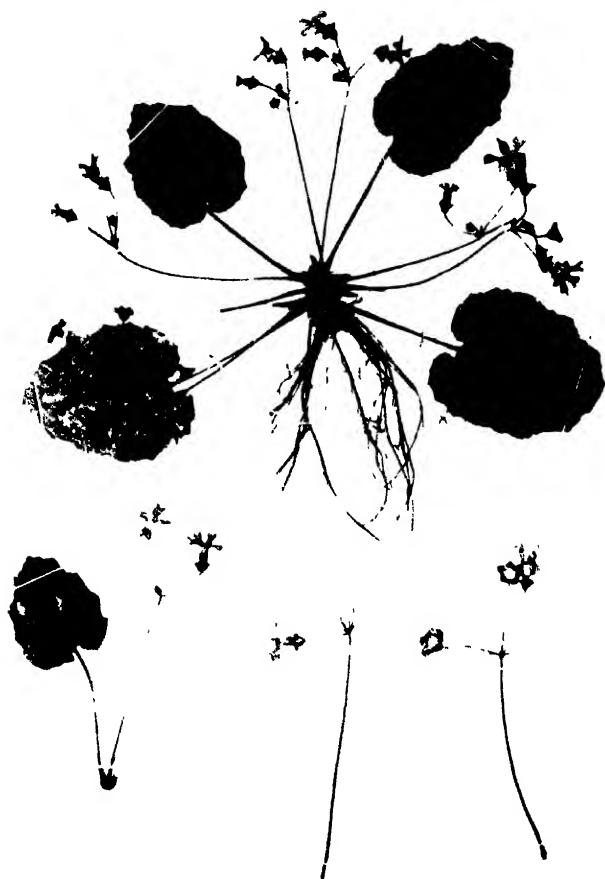
Herb. G. Mac

Primula austrolisteri, Balf. fil. In Herb. Edin.

PROFESSOR RAYNER RAIFOUR



Primula filipes, Watt. Type in Herb. Kew.



Leafy stems with the flowers
 from a plant in the garden at
 Calcutta.

1840. 1841. 1842. 1843.

1. The first year.

2. Second

3. Third year.

4. Fourth year.

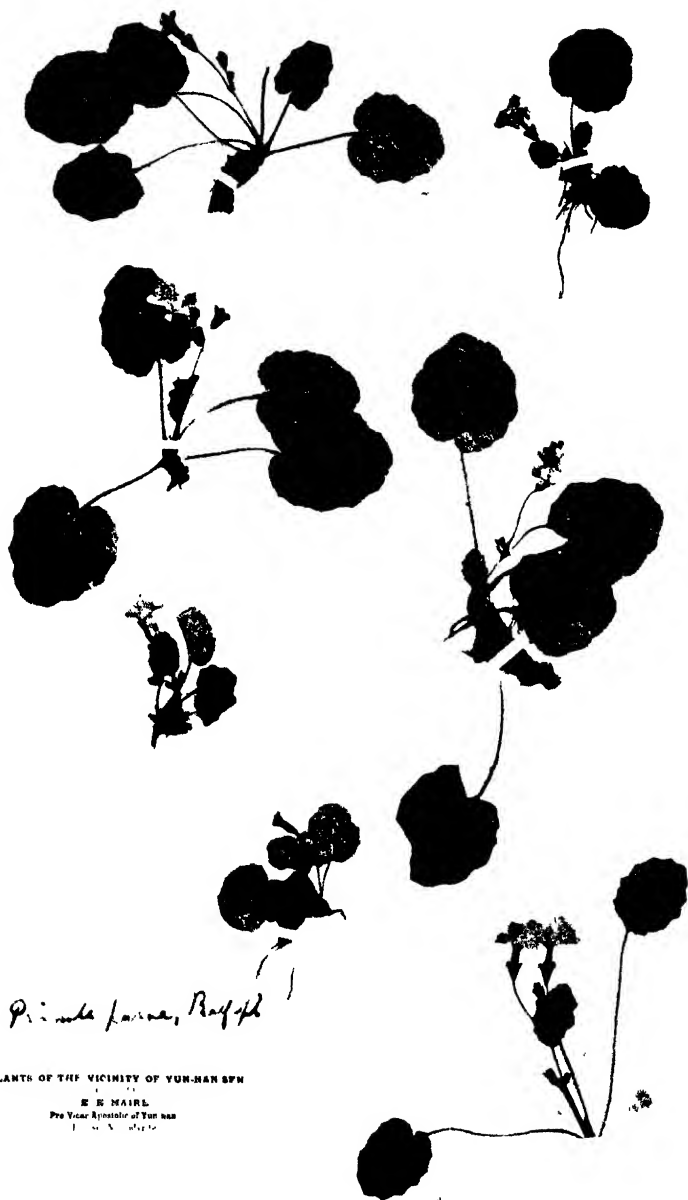
Primula obconica Hance.

var. *capitata* Hance.

good
 from Calcutta.

Primula obconica, Hance. Burmese plant. In Herb. Calcutt.

Professor BAYLEY BALFOUR.



Primula parva, Benth.

PLANTS OF THE VICINITY OF YUN-NAN SEN

E. H. NAILL

Pro Vicar Apostolic of Yun nan

1890

No. 924

Primula parva, Benth. fil. In Herb. Edin.



DR. AUG HENRY'S COLLECTIONS FROM
CENTRAL CHINA, 1885-86.

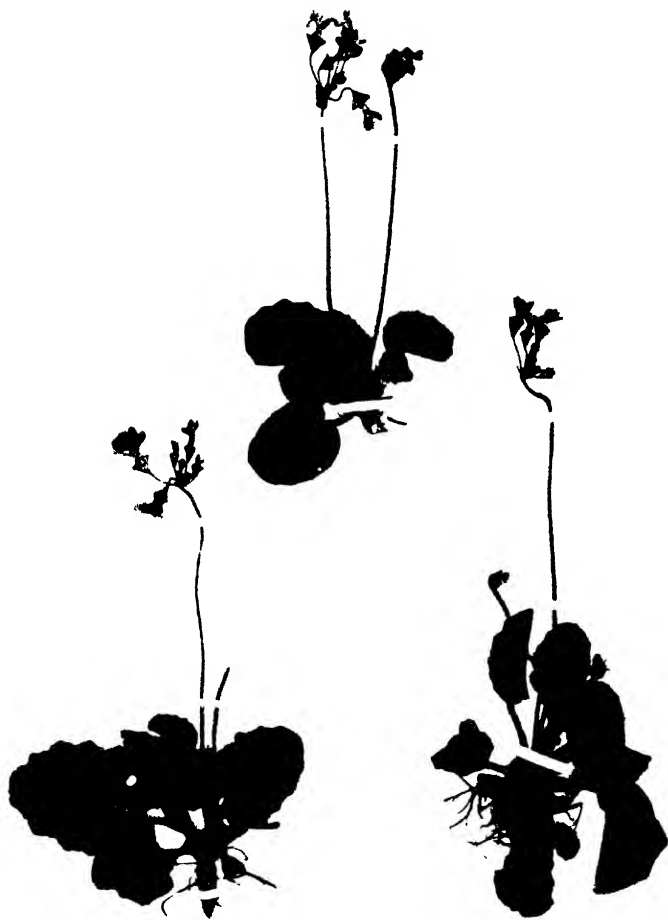
NO. ~~4878~~ = 1312

Primula obovata, Hance

Prov. HUPEH.

Primula obovata, Hance. Forma. In Herb. Edin.

Professor BAYLEY BALFOUR.



HERB MRS PARIS

1921 г. 12.12.1921 г. 12.12.1921 г. 12.12.1921 г.

Plan 1000 191-312
Recher. en (un) de fibres, l'au
à Y-tchong (Houng)
62 mar 1892

Plaques de CHINA (Proximité du Yen-Yan)
 25 1 1/2 lb. DRY VANS (100% 100%)

Primula obconica, Hance. Forma In Herb. Paris.

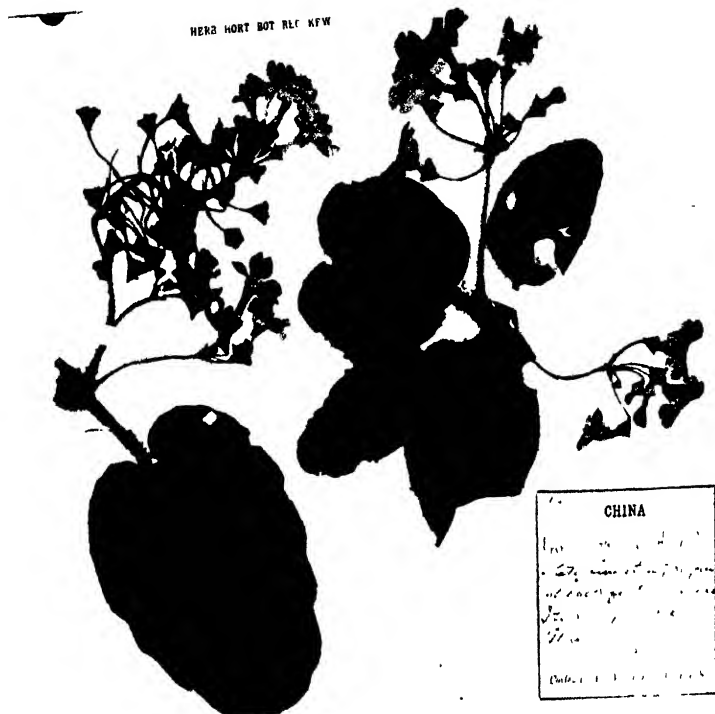
Professor BAYLEY BALFOUR.

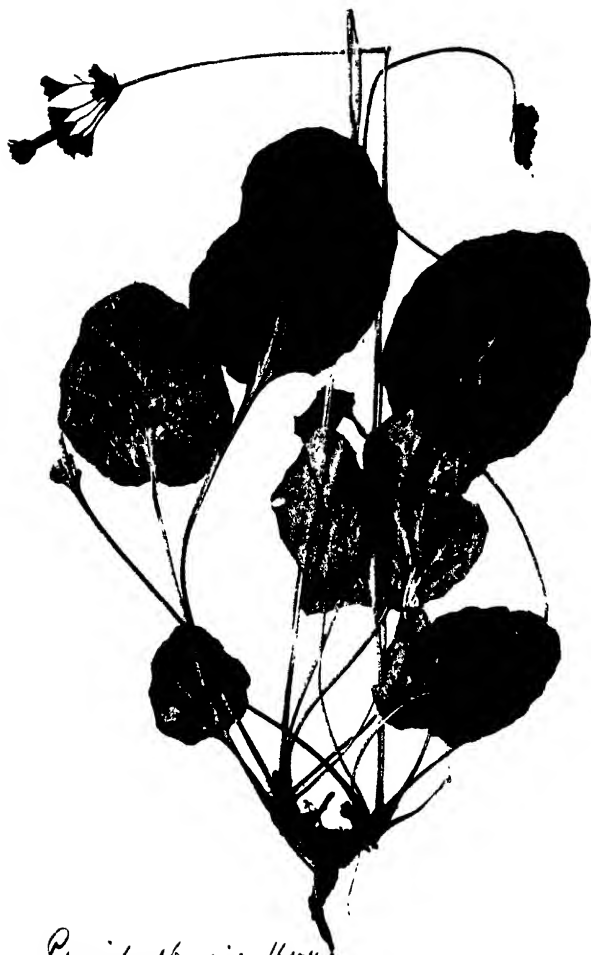


Primula obconica
 in flower 1869
Primula
A. d'umbellata-jamata
 Rocher d'Inver

Primula obconica, Hance. Forma. In Herb Paris.

Professor BAYLEY BALFOUR.





Primula obconica, Hance

(PLANTES DE CHINE (YUNNAN))

© BONATI. Reproduction de la gravure LURE (1890)

Primula obconica, Hance
 (Plantes de Chine (Yunnan))
 © Bonati. Reproduction de la gravure LURE (1890)

Primula obconica, Hance. Forma. In Herb. Bonati.

Professor BAYLEY BALFOUR.



Prunella chinensis, Hance

PLANTES DE CHINE (YUNNAN)

à BONATI (Herb. de l'École de Médecine de Paris)

Prunella chinensis, Hance. In Herb. Bonati.
 Prunella chinensis, Hance. In Herb. Bonati.
 Prunella chinensis, Hance. In Herb. Bonati.
 Prunella chinensis, Hance. In Herb. Bonati.
 Prunella chinensis, Hance. In Herb. Bonati.

Prunella chinensis, Hance. Forma. In Herb. Bonati.

Professor BAYLEY BAI FOUR.



Primula abconica, Hance

PLANTES DE CHINE (YUNNAN)

BOULEVARD DE LA VILLE DE PARIS

1895

1895

Primula abconica. Hance. Forma. In Herb. Bonati.

Professor BAYLEY BALFOUR.



PLANTES DE CHINE (YUNNAN)

G. BONATI, Pharmacien de 1^{re} Classe, LURE (Hte-Saône)

Herb. Bonati
Lecture par
Leg. R. P. Martin
Lecture par
Lecture par

Primula obconica, Hance. Forma. In Herb. Bonati.

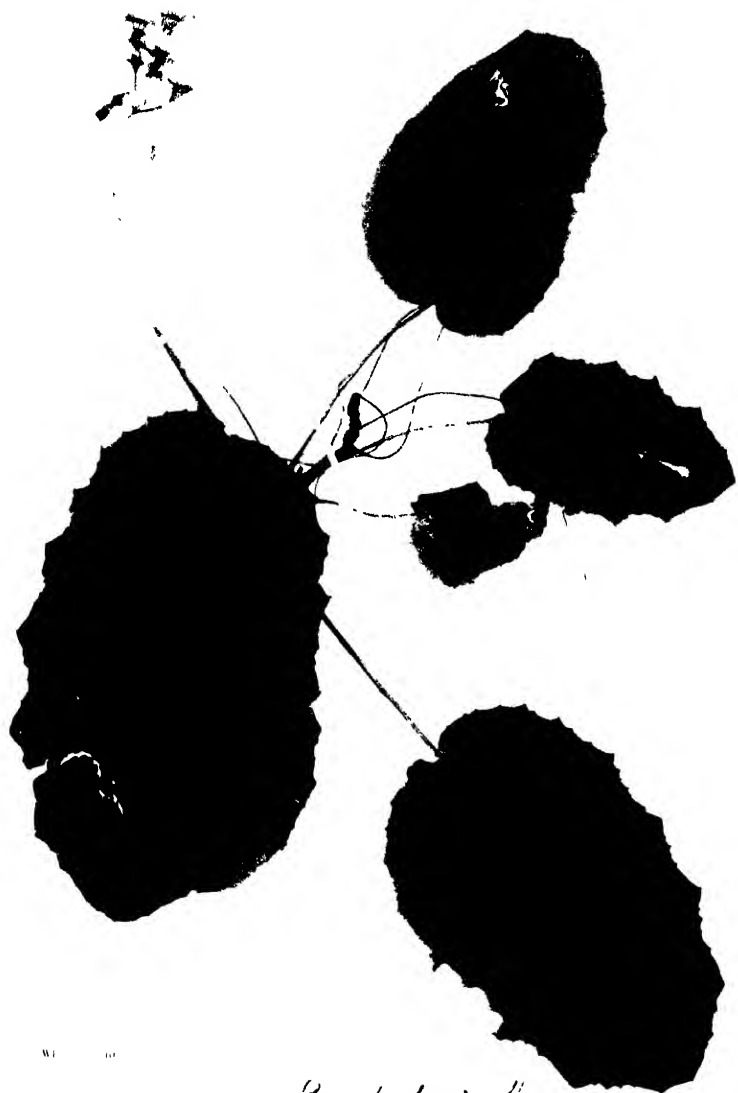
Professor BAYLEY BALFOUR.



Primula ambita, Balf. fil. In Herb. Paris.

Professor BAYLEY BALFOUR.

HERB. VORT ROT HIG KEW



Primula obconica, Hance

PRESENTED BY

Messrs. J. VEITCH & SONS, 1900

Primula obconica, Hance. Forma. In Herb. Kew.

Professor BAYLEY BAUFORD



Primula obconica, Hance. Forma. In Herb. Brit. Mus.



THE UNIVERSITY OF ALABAMA

10.000.000 ist weniger m
Geld

1. *Field of view*

JUN 25 1987 11 11 AM EST

Primula Petitmontani, Bouati. In Herb. Paris.

Professor BAYLEY BALFOUR.



Primula Vilmoriniana, Pettin. In Herb. Paris.

Professor BAYLEY BALFOUR.



P. sinolisteri, Balf. fil.

PLANTS OF S. TIBET AND S.W. CHINA
 Collected by GEORGE FORREST
 T. & A. BULLY of HEMA, NORTON, CHEONGHAI
Primula *obovata* *hookeriana*
var. glaberrima, *bracteata*
 Plant 4 ft. - 5 inches tall
 white lvs greenish-yellow,
 fragrant.
 Dry rocky pastureland in the
 Yang-tse valley western slopes
 of the Salu Range.
 Alt 26,000 ft. alt 7,900 ft.
 May 1926 to Yunnan China.



178

PLANTS OF S. W. YUNNAN
COLL. H. S. GUNDEL 1907

Primula begoniformis, Pettm. In Herb. Edin.

PROFESSOR BAYLEY BALFOUR



LEE & MEN PERS

Primula No 307
yonge de p...
a ju...
h. 110. 1823

Primula beyoniiformis

CHM. J. A. S. V.
M. A. B. C. S. S. S. S.

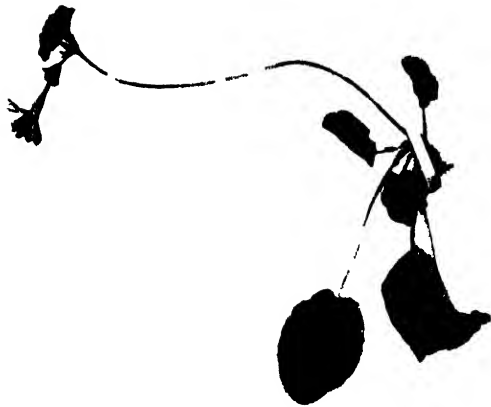
Primula beyoniiformis, Petitm. In Herb. Paris.

PROFESSOR BAYLEY BALFOUR.



Primula 1845.
begonifolia.
 Dans la rochers alpins de la vallée
 au-dessus de la source de la rivière
 près de la source de la rivière
 à 2800^m d'alt.
 le 26 avril 1845. *Ag. Petit*

Primula begonifolia, Petit. In Herb. Paris.



PLANTES DU YUNNAN (CHINE)

G BONATI, Illustration de 1^{re} Classe, LIRE (Haute-Savoie)

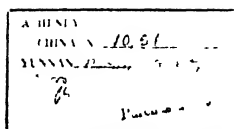
N^o 492 ^{sur} *Delavay* 1885
Primula Bonati Knuth! (type)

Lo-houy-ehou p^{re} ly-li.

Determiné par Dr Knuth.
Récolté le 26 avril 1907.
Lug: Paul-Agouin

Primula Bonati, Knuth. Type in Herb. Edin.

Professor BAYLEY BALFOUR.



Prunella barbadensis, C. H. Wright In Herb. Edin.



A. HENRY
CHINA, No. 11999
YUNNAN - Specimen, 287 mm
4000' - Solo bird in the
Purchased 1909.

Primula barbicalyx, C. H. Wright. Forma. In Herb. Edin.

Professor BAYLEY BALFOUR.



Moupin, three oris
 April 1869
 Primula
 # Rouge for
 Mont Faich

Primula oreodoxa, Franch. Type in Herb. Paris.

Professor BAYLEY BALFOUR.

THE FLORA OF THE CULBIN SANDS. By DONALD PATTON,
M.A., B.Sc., and E. J. A. STEWART, M.A., B.Sc.
(Six maps, two figures, and Plate LVII.)

(Read 9th April 1914.)

The Culbin Sands, the flora of which is described in the following paper, lie on the extreme west of the seaboard of Elginshire. They occupy the greater part of the promontory between the Moray Firth and the western shore of Findhorn Bay, and they stretch for upwards of six miles along the coast and have a maximum breadth of three miles. To the south lie the fertile reaches of the River Findhorn and the Muckle Water, while on the west the Culbin Sands, here known as the Maviston Sandhills, which enter some short distance into Nairnshire, are succeeded by flat heath and marsh.

History.

It appears that at least a part of the area now included in the "Sands" was formerly within the great fertile plain which occupies the "province" of Moray between the hills to the south and the sea to the north. The estate of Culbin was, indeed, so productive that it was known as the "Granary or Garden of Moray." The farm-lands just beyond the belt of woodland which bounds the sands on the landward side yield crops of wheat which are among the heaviest per acre in the British Isles. Local tradition ascribes a sudden origin for the modern condition of the Culbins. The story¹ is that in 1694 Culbin estate was overwhelmed by immense masses of sand, driven by a strong west wind from the shores of the Moray Firth. Such was the fury of the storm that in a few days from its commencement every vestige of houses and fields was obliterated. The ruined proprietor successfully petitioned the Scots Parliament for relief of land-tax. Further, an Act was passed prohibiting for all time under severe penalties the pulling of bent, juniper, or broom, to which cause the sand-drift was expressly attributed. Other

¹ Bain, *The River Findhorn*, pp. 226-228.

modern authorities hold that this calamity was but a culmination of many attacks by the sand, and that it is absurd to believe that all the ground now covered was formerly cultivated. Accounts are certainly extant of previous sand-storms and floods, and the area must have invited invasion from seaward by reason of its low elevation. One map shows a line, well towards the landward side of the dunes, which represents a former line of coast. The gravel beds found far in among the sandhills are supposed to be former sea-beaches. The River Findhorn, too, is stated to have flowed westward through what is now a region of dunes, until it was choked by sand-storms and forced into its present course through Findhorn Bay on the east.¹

Climate.

The climate of the Culbin area, like that of the rest of the seaboard of Elginshire and that also of Nairnshire, is distinguished by its low rainfall. The district is said to have forty days "fair weather" more than any other in Scotland. A medical report on the county of Nairn, which touches the area under consideration on the west, says that "the average rainfall is a fraction over twenty inches annually. This is owing to its geographical position, being bounded by hills to the north, south, and west. The average maximum temperature is 52·55, and the minimum 39·17. . . . During March, April, and May north and east winds are in some seasons troublesome, while the rest of the year south and south-west winds prevail. With few exceptions the winters are not severe; very little snow falls, and frost does not hold long sway, while mist and fog are seldom seen." Of Moray, Sir Robert Gordon of Straloch, in the seventeenth century, says: "In salubrity of climate Moray is not inferior to any, and in richness and fertility of soil it much exceeds any of our Northern provinces. The air is so temperate that when all around is bound up in the rigour of winter, there are neither lasting snows nor such frosts as damage fruit or trees."

¹ The historical problem is discussed throughout the contributions of Bain, The River Findhorn; Murdoch, Notes on a Visit to the Culbin Sands, Morayshire; and Ewing, The Flora of the Culbin Sands.

The great storm on the Culbins came with a west wind, and winds from the same direction are said, as above noted, to be still the prevailing.¹ The arrangements of the blown sand and the changes in its position certainly suggest that this is the case.

Geology.

The Culbin Sands, according to Craig, rest upon the 25-foot beach which extends from Inverness to the mouth of Findhorn and which is here especially broad, the 100-foot terrace at Kintessock being about $2\frac{1}{2}$ miles from the present coast.²

The sand is finely pulverised and free from shells, pebbles, or organic remains.³ The particles are mostly about $\frac{1}{160}$ inch in diameter, according to Mackie,⁴ and show a very high degree of rounding. This is due to the fact that the sands owe their form largely to the action of wind.⁵ The sand shows a preponderance of kaolinised felspars, about 73 per cent.⁶ Mackie gives the results of an examination of a specimen of Culbin sand with mineralogical constituents and degrees of rounding.⁷ Another examination shows the "inordinate disproportion of the quartz to the felspar and other constituents." Out of 100 particles, 78 were quartz, 18 felspar, 1 composite fragment of quartz and felspar, 1 flake of mica, 1 fragment of garnet, 1 either a particle of magnetite or a chip of hornblende, tourmaline, zircon, or sphene.⁸ With regard to the source of the sand, Mackie compares the felspars with those of the Ardclach and Kinstearly granites,⁹ and also compares the size of the sand-grains with those of the rivers Findhorn and Nairn, "from which we have reason to believe they have in large

¹ "260 days in the year at Forres"—Craig, *The Culbin Sandhills*, p. 528.

² Craig, *The Culbin Sandhills*, p. 526.

³ *Ibid.*, p. 527.

⁴ Mackie, *On the Laws that Govern the Rounding of Particles of Sand*, p. 311.

⁵ *Ibid.*, p. 300.

⁶ Mackie, *The Felspars Present in Sedimentary Rocks as Indicators of the Conditions of Contemporaneous Climate*, p. 459.

⁷ Mackie, *On the Laws that Govern the Rounding of Particles of Sand*, p. 307.

⁸ Mackie, *The Sands and Sandstones of Eastern Moray*, p. 148.

⁹ *Ibid.*, p. 150.

part been derived.”¹ Craig, Murdoch, Ewing, and others support the view that there is a sort of circular movement of the sand, it being blown into the estuary of the Findhorn, carried out to sea, washed by currents on to the north and west shores of the Culbins, blown by the wind again on to the dunes, and so *de novo*.²

In such parts rich in vegetation as the dune-marshes, much soil has been formed by the decay of that vegetation. It is more or less blended with sand, previously there or since blown on the surface.

In certain places the old black soil, some of which was cultivated in the seventeenth century, appears. Sir Thomas Dick-Lauder obtained forty-six plants of four species of “field-weeds” grown from two saucerfuls of it.³

PHYSIOGRAPHY AND DISTRIBUTION OF VEGETATION.

(See Maps I and II.)

Until 1876 the north-eastern portion of the promontory, Binsness, was a bare, exposed hill showing little but sand. Since that date a dense wood, consisting mainly of *Pinus sylvestris*, Linn., has been established there. Planted forest of pine bounds the whole southern or landward margin of the Culbin Sands. Narrow towards Findhorn Bay, this wood becomes broader towards the west, and on that side extends more nearly to the shore of the Moray Firth.

Between the pines of Binsness Wood and those of the southern belt, dunes of comparatively low elevation, mostly fixed and bearing a considerable vegetation, reach to within a few yards of the Bay. Loose or partly bound sand occurs among them and about their eastern bases, while from them sand is blown to the flats adjoining the shoreline and into the estuary of the River Findhorn. On these flats are to be found representatives of the sand floras as well as many of the plants of the littoral marsh. On the west side of these dunes is a space of low elevation on which the ground vegetation is on the whole close. A birch wood which extends from the Binsness pine wood

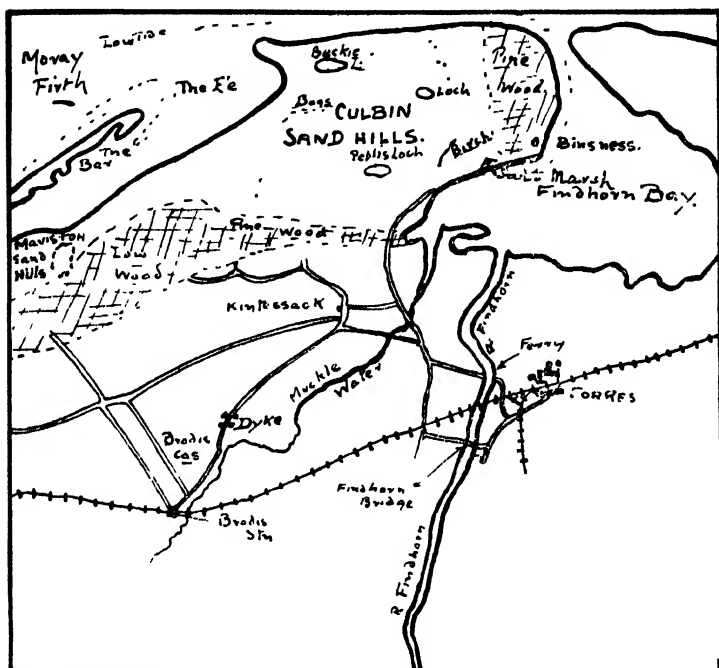
¹ Mackie, *The Sands and Sandstones of Eastern Moray*, pp. 167-168.

² Craig, *The Culbin Sandhills*, pp. 530-531. Murdoch, *Notes on a Visit to the Culbin Sands, Morayshire*, pp. 410-411.

³ Murdoch, pp. 411-412.

almost to the southern margin of the sands, occupies the western part of this flat area.

To the west and north are the Culbin Sandhills proper. They extend to the northern shore on the Moray Firth and include the barren, shifting dunes (some of which are 120 feet high), and ridges, table-lands, hollows, and flats



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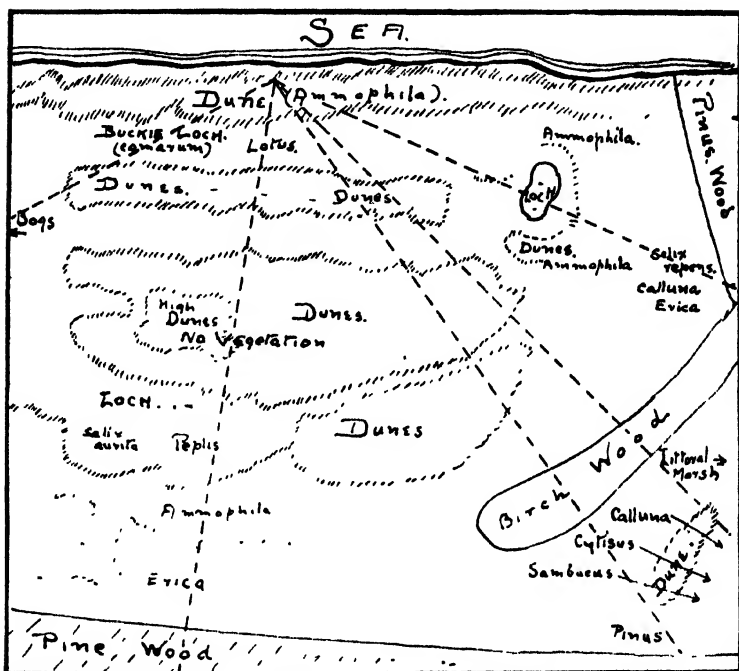
MAP I.

Map showing situation and principal features of Culbin Sands.

in various progressive and retrogressive stages of fixation by vegetation. Some of the low-lying spaces among these sandhills are covered with gravel; others have a layer of sand over peaty soil, which last appears in well-defined stratification in certain escarpments of the dunes. These "Culbin Sandhills" also enclose the dune-marshes, which, true lochs in the wet seasons, dry up more or less completely during the late summer and the autumn. These so-called "lochs" maintain around their margins and in their beds, when free from the water-covering, a peculiarly

rich and varied flora, even in the very heart of the bare sand-desert.

To the west of this region of the Culbin Sandhills proper, described in the above paragraph, is one in which the high dune formation is mostly confined to the Maviston Sandhills on the landward margin.



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MAP II.

Map showing distribution of vegetation in eastern portion of Culbin Sands—
"Culbin Sandhills" proper and "Findhorn Bay Margin."

Classification of the Area.

In accordance with the foregoing description of the varied nature of the area of the Culbin Sands, the variation of sandy covering, of dune elevation, of subsoil, of water content, of exposure and other factors, and the corresponding variation in vegetation characteristic of these several regions, the flora of the Culbins may be classified and discussed under the following topographical districts and plant associations:—

A. Findhorn Bay Margin—

1. Salt-Marshes.

2. Fixed Dunes, adjoining on the west the Salt-Marshes, and in several places passing into and combining with them.

(a) Sandy Flats.

(b) Sandy Ridges.

B. Culbin Sandhills proper—

1. Shifting Dunes.

2. Fixed Dunes.

3. Dune-Marshes.

C. Maviston Sandhills—

1. Fixed Dunes.

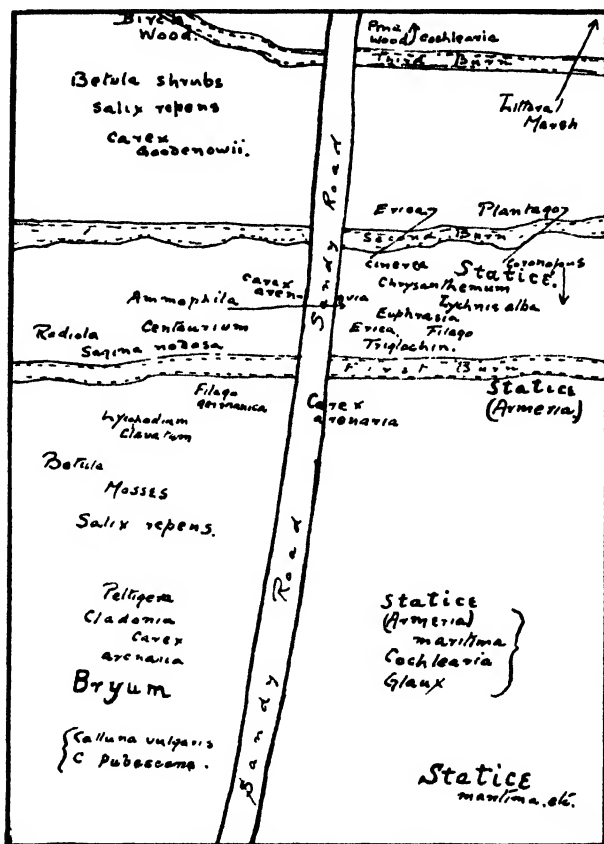
2. Shifting Dunes.

A. FINDHORN BAY MARGIN.

The road which gives most convenient access to the Culbins enters at the south-west corner of Findhorn Bay and continues in a northerly and north-easterly direction through the sand, along the flat which is bounded on the east by Findhorn Bay, on the west by a ridge of fixed dune and the north end of the birch wood, until it leaves the sands again at Binsness Wood. The flora of these flats and the ridges which are properly included in the same division, owes its striking combination of salt-marsh and fixed-dune characters to the fact that, while the region lies to leeward of the shifting dunes and, in one sense, to landward of the seashore from the direction of which the prevailing westerly winds carry the sand, it at the same time is close beside the tidal waters of Findhorn Bay. Thus, on one side are found purely sand-dune associations, where the substratum of sand is blown in from the shifting dunes; on the other are salt-marsh plants where the muddy soil is washed by the estuarine water. Further, although one may conceive a sort of normal boundary where these two influences meet, instability and a mixed character are given to the associations by the blowing of sand in exceptionally high winds on to the salt-marsh, in places resulting in the growth of sand-plants above buried marsh-plants, and by the flooding of the sandy areas in high tides with resultant changes in the soil and the vegetation.

1. Salt-Marshes. (See Map III.)

Throughout the coast-line of the Culbin Sands, extending for upwards of six miles, littoral marsh only exists in any



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MAP III.

Map showing distribution of vegetation in "Findhorn Bay Margin" area—Northern Section.

noteworthy degree along this small stretch by Findhorn Bay. On the north shore, by the Moray Firth, the tide reaches right up to the base of the high coastal dunes. This accounts for the scarcity of plants of any kind along that sea margin, and it is only by the Bay of Findhorn that the Culbin Sands area presents an association of

plants resembling a seaside flora. The vegetation here, however, is not fully typical of a seashore. For, although the low-lying land along the margin of the Bay has every appearance of being swept by the higher tides during the stormy months of the year, the waters of the Bay are estuarine, and the comparatively low salinity renders the flora characteristic of a brackish-water area rather than of the seaside proper. The plants are not those characteristic purely of sea-coast, but those found both on sea-coast and beside brackish water. Such plants as are frequent along the seaboard of Ayrshire or Fifeshire, as *Calystegia Soldanella*, Br.; *Eryngium maritimum*, Linn.; *Thalictrum minus*, Linn.; *Astragalus danicus*, Retz., were not found by the Culbin Sands.

The dominant plants of this salt-marsh association are *Statice maritima*, Mill.; *Plantago Coronopus*, Linn.; *Littorella uniflora*, Aschers (*lacustris*, Linn.); *Glaux maritima*, Linn.; *Cochlearia officinalis*, Linn.; *Triglochin maritimum*, Linn.; *Aster Tripolium*, Linn.; *Juncus squarrosus*, Linn.; *Carex Goodenowii*, Gay.¹

A specially noticeable feature in this area is the dominance of the *Statice maritima*. It increases in abundance nearer the water, and here also its foliage is particularly red. This plant shows most distinctively among the littoral species the cushion growth which is characteristic of so many of the dune plants.

2. Fixed Dunes.

(a) Sandy Flats. (See Map III.)

Westward of the salt-marsh the surface continues at about the same level; but the soil is more or less deeply composed of sand. On the dry flats here the mat-like or cushion growths are better exhibited than in any other association of the Culbins. On certain parts of the fairly firm sand *Calluna vulgaris*, Hull., is dominant, and its habit is this mat-like growth, in dense compact circles sometimes more than a yard in diameter, more often from 12 to 18 inches. Between these mats are bare spaces of

¹ In this and other lists of plants throughout the paper, the species are given in rough order of frequency of occurrence.

sand. Similar mats are found in the same part of the flats, formed of *Calluna vulgaris*, var. *pubescens*, Hull., which has a hoary appearance, due to the covering of the stem and leaves with close, short, whitish hairs. It is to be expected that such a condition, with its help in reducing transpiration, should be found in a plant growing on open sand, exposed to sun, wind, and defective water supply, so corresponding with the fleshy condition in the neighbouring littoral plants, which defends them against the same danger arising in a different environment. This hairy ling grows elsewhere on the fixed dunes of the Culbins; nor is it peculiar to the sands, for it is to be found on the heaths of the hills inland, near Pluscarden, and in the forest of Altyre.

The cushion condition which is so well shown in these *Callunas*, both the common one and the hairy variety, is, still more than hairiness, a striking feature of the flora generally on the fixed dunes. The long, single main stem branches profusely at the surface of the sand, the branches spreading horizontally.

On the same flats as the *Callunas*, but at other parts, are somewhat similar circles of *Rumex Acetosus*, Linn. "Pads" of *Juncus squarrosus* are found in most parts of the flats.

Mosses are prominent in the vegetation of the Culbin Sands, frequently being first to colonise the settling sand. They have much effect in binding the sand, as is found when an attempt is made to remove a specimen from the firmly matted mixture of moss and sand under the surface. Mosses are in some places the only vegetation on the sand; but also, where there is a close covering of angiosperm plants, mosses are commonly to be found underneath the taller herbage, spreading densely over the surface of the soil. Lichens play a similar but less extensive part and show a lesser number of species.

In the neighbourhood of the *Callunas*, *Bryum*, sp., takes a leading part in initiating the sand-binding. The lichen, *Peltigera canina*, Hoffm., dominates much of the sand alone, and *Cladonia rangiferina*, Nyl.; and *Cladonia pyxidata*, Fr., also cover much space.

Burnside flora. — Three small burns cross the flats,

running into Findhorn Bay. Each has a distinctive character in the flora of its banks.

The most southerly contains much iron hydroxide. The plants by it are low-growing. The habitat partakes somewhat of the characters of both fixed dune and salt-marsh, which are both seen pure near by. The sandy substratum is apparently exposed to periodic floods. *Carex arenaria*, Linn., mingles with the fleshy-red *Statice maritima*; *Glaux maritima*; *Plantago Coronopus*; and *Littorella uniflora*. *Centaurium vulgare*, Rafn., in which the tufted or cushion growth is strikingly carried out in the branches of the inflorescence, is conspicuous. *Sagina nodosa*, Fenzl., is also abundant, and *Sagina procumbens*, Linn., is frequent. *Radiola linoides*, Roth., is locally dominant, branching abundantly just at the surface of the soil.

In one small area, farther down the burn, come together *Triglochin maritimum*; *Euphrasia officinalis*, Linn.; *Filago germanica*, Linn.; *Erica Tetralix*, Linn.; *Erica cinerea*, Linn.; and *Juncus squarrosus*.

Another grouping in this quarter is of *Statice maritima*; and *Cochlearia officinalis*; with *Lychnis alba*, Mill.; *Atriplex patula*, Linn.; and *Rumex Acetosella*, Linn.

Where the littoral marsh between this and the next streamlet passes westward into sand grow a dwarf *Chrysanthemum segetum*, Linn.; *Senecio Jacobaea*, Linn.; *Sonchus asper*, Hill; *Solanum Dulcamara*, Linn.; and *Salix aurita*, Linn.

At the second burn *Erica cinerea* mingles with *Plantago Coronopus*. On the sandy flats, widening out here to the northward, is a curious patch, dry in dry weather, with shrubs of *Betula tomentosa*, Reith. et Abel; *Alnus rotundifolia*, Mill.; and *Salix aurita*, with *Salix repens*, Linn.; and *Carex Goodenowii* subdominant. Also present are tussocks of *Erica Tetralix* and *Juncus squarrosus* and *Potentilla Anserina*, Linn.

The most northerly burn comes from the Binsness pine wood and passes through a strip of the birch wood. The soil in both woods here is sand; but the ground vegetation differs. Under the birches are long *Erica cinerea* and shorter *Calluna vulgaris*, with the mosses *Hylocomium squarrosus*, B. et S.; *Thuidium tamariscinum*, B. et S.;

and the lichen *Cladonia rangiferina*. Under the pines very short *Calluna vulgaris* is supremely dominant.

Between the south-east margin of the pine wood and the Bay, marsh with *Atriplex patula* dominant is succeeded to landward by a mingled grouping of *Atriplex patula* and *Carex arenaria*. Hereabouts a tall clump of *Hieracium corymbosum*, Fr., is conspicuous.

(b) *Sandy Ridges*. (See Map IV.)

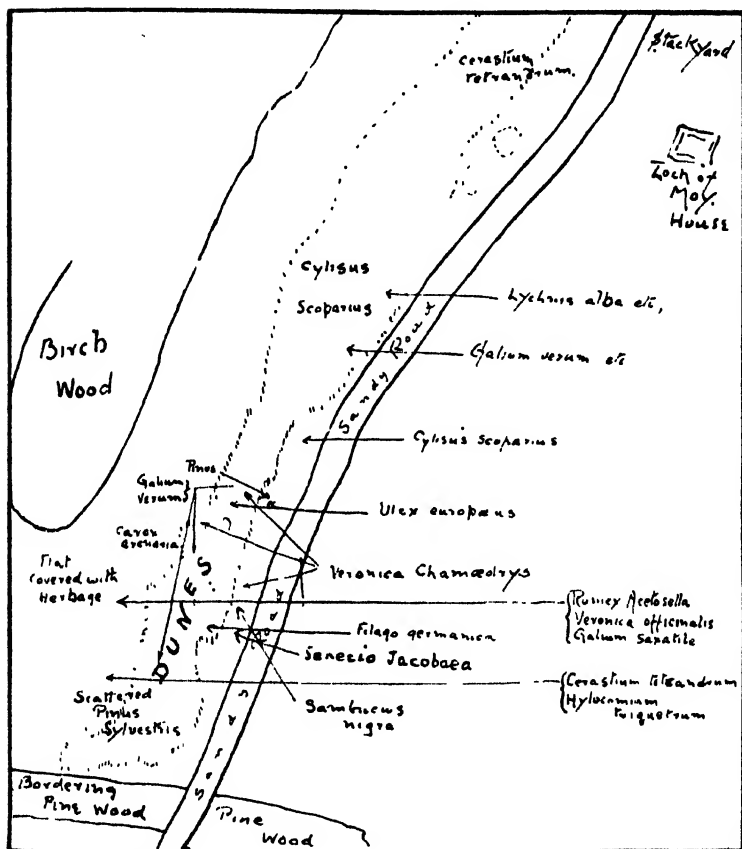
On the south-west the flats, which have been treated above, rise in the ridge of fixed dune. At their north end, however, the flats extend farther westward and reach the birch wood. At the south end, again, the flats, on which there is typical sand-flora, narrow, not much more than the breadth of the road mentioned intervening between the eastern foot of the slope and pasture-land with typical pasture-land plants.

The dune which separates the flats from the rest of the Culbins is well covered with vegetation, especially at the southern end. There scattered and aged individuals of *Pinus sylvestris* are growing. There, too, the mosses form a leading feature in the ground vegetation, growing over the surface of the sand where there is little other covering, and also forming a close mat under and among the herbage. *Hylocomium triquetrum*, B. et S., is dominant. *Hylocomium squarrosum* and *Thuidium tamariscinum* are very abundant. *Peltigera canina* is another locally dominant covering associated with *Cladonia rangiferina*. On the ridge and western and eastern slopes the most frequent of the angiosperms are *Cerastium tetrandrum*, Curt.; *Lotus corniculatus*, Linn.; *Galium saxatile*, Linn.; and *Senecio Jacobaea*. The last is an outstanding feature of the Culbin flora and is found in very varied habitats, having been taken in the salt-marsh, on the flats, the higher fixed dunes and the shifting dunes, and the dune-marshes.

At the other end of the ridge where the formation is rather of an irregular arrangement of numerous small fixed dunes, *Luzula campestris*, DC.; *Viola canina*, Linn.; *Veronica officinalis*, Linn.; and *Rumex Acetosa*, are very common, and *Pyrola media*, Sw., is frequent.

Hypnum cupressiforme, Linn., is one of the dominant

plants on the barer parts where the sand-dunes give place to the sandy hollows. Here, too, *Carex arenaria* grows plentifully, not only on the bare sand, but mingled with other and close herbage.



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MAP IV.

Map showing distribution of vegetation in "Findhorn Bay Margin" area—Southern Section.

Veronica Chamaedrys, Linn., is in great abundance on the dune in the loose sand scraped out by rabbits before the mouths of their burrows. Another plant which thrives particularly well in the same habitat is *Galium verum*, Linn.

Salix repens grows in great profusion at various parts

of the dune, especially on the lower ridges and the intervening hollows at its north end. This plant is, indeed, locally dominant in every region of the Culbin fixed dunes, growing low and appropriating considerable stretches.

Filago germanica shows an adaptation to different conditions. At the north end of the dune it grows on bare, open sand, and has the typical cushion growth of such situations. But at the south end it is found on the leeward slope, in a sheltered position, and here the stem is elongated above the ground and is unbranched.

A considerable portion of the eastern slope of the dune near the south end is clothed with shrubs of *Sambucus nigra*, Linn., which do not appear to be in a very healthy condition and are the host of fungus and lichen. Beneath and around these bushes the sand is bare and there *Senecio Jacobaea* grows.

Farther north the leeward side of the dune is covered for some distance with a dense thicket of *Cytisus scoparius*, Link. The ground vegetation consists chiefly of *Galium verum* and *Cerastium tetrandrum*, with frequent *Taraxacum officinale*, Weber; *Bellis perennis*, Linn.; *Veronica officinalis*; *Plantago lanceolata*, Linn.; *Luzula campestris*; *Alchemilla arvensis*, Scop.; and the moss *Polytrichum commune*, Linn. One patch of broom is withered, and beneath and beside it *Urtica dioica*, Linn., grows luxuriantly. The nettle is so often the first plant to colonise an area which has been devastated by fire that the condition of the broom and the presence of *Urtica* suggest the reason for this particular grouping.

Another grouping of plants found on the fixed dune includes *Lychnis alba*; *Cerastium vulgatum*, Linn.; *Viola canina*; and *Senecio Jacobaea*.

Numbers of spurs from the dunes into the flats are covered with *Ceratodon purpureus*, Brid., a moss which does much in colonising and binding the sand.

In the Scottish Act of Parliament which was passed after the great Culbin disaster, bent, broom, and juniper are mentioned as plants to be protected. Bent is the commonest plant on the Culbins taken as a whole, its habitat being the sandhills of looser material. Broom has been mentioned as an inhabitant of the eastern fixed dunes,

but it is only in this area that it occurs on the Culbins in any quantity. Juniper was not found by the authors.

B. CULBIN SANDHILLS PROPER. (See Map II.)

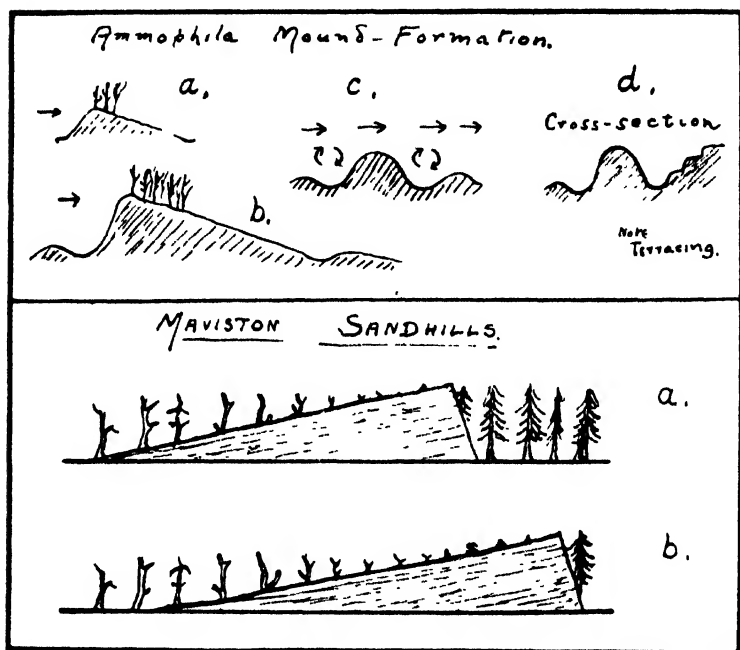
1. *Shifting Dunes.*

The highest dunes, where the fine sand moves about incessantly under the prevailing westerly winds, are almost completely devoid of vegetation. These are adjoined, however, by lower dunes, fairly well covered with vegetation, especially *Ammophila arenaria*, Link., by ridges carrying *Ammophila* alone on their tops, and by dunes and plains among which rise individual hillocks clad with and built up by means of *Ammophila*. These formations are particularly clear on the eastern side of the highest dunes.

MARRAM GRASS ASSOCIATION.—The characteristic plant of the "white" dunes, the plant which grows among the shifting sand where no other vegetation is visible as far as the eye can reach, is *Ammophila arenaria*. In certain parts it has been planted; but most of it is obviously of natural origin. The mode of formation of the isolated tufts or hillocks or ridges of it is frequently apparent.

At first one or two stems take firm root and grow in the comparatively stable sand. The persistently westerly winds heap up a little slope of sand against the western edge of the tuft, throwing a heap of sand among the bases of the stems (see fig. 1, *a*). The sloping sand on the west increases in bulk, retaining its steepness, the Marram grass becomes more and more lifted up on a mound and grows upward and keeps its leaves above the surface of the sand. The sand blown over the hillock and off its top and along its sides accumulates in a tail on the eastern side. In form the mound thus takes on the crag-and-tail appearance, which is also possessed, in the reverse direction, by the dunes themselves (see fig. 1, *b*). In the course of time the hillock becomes more and more flat-topped and elongated, with Marram grass growing along the summit. Many irregularities in shape, of course, occur, as the joint-effects of the situation, the sand, the wind, and the plant-growth. Another general effect is the hollowing-out action of the wind, which, coming against the mound, is forced down-

wards and scoops out a hollow in front, to windward of which again may rise a smaller mound of sand or of sand bearing Marram grass (see fig. 1, *b* and *c*). Similarly a hollow may be scooped out to leeward of the main hillock (see fig. 1, *b* and *c*). Hollows are also formed sometimes at the sides, sometimes with terraces in their outer banks at different levels, presumably due to winds of different force and coming from various directions (see fig. 1, *d*).



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FIG. 1.—Above : Showing formation of mound with *Ammophila arenaria*, Link.

FIG. 2.—Below : Showing shape and mode of advance of Maviston Sandhill.

A constant feature in connection with the *Ammophila* is the dark deposit, apparently in the main organic debris from the dead plants, which gathers on the surface of the sand or streams down the slopes, always on the same eastern or leeward side. It is present even at the smallest tuft.

Although the Marram grass, where it becomes established upon the sides of a long ridge, seems to keep the sand well fixed, yet the isolated mounds referred to have frequently

the appearance of instability. Sooner or later the sand gets blown away and the lower haulms and the roots become exposed in the little "sand cliffs."

Along the northern shore of the Culbins is a ridge which has the Marram grass well distributed, and the landward slope of the same dune shows this plant, alone on the shifting sand of the summit, losing its dominance as the conditions change towards the foot to fixed dune, and at some points to dune-marsh.

2. Fixed Dunes.

SAND SEDGE ASSOCIATION.—The commonest plant in the hollows—which may be floored with gravel scattered in fixed sand, with pure fixed sand, or with fixed sand in a thin covering over peaty soil,—which lie right among the high barren shifting dunes, is *Carex arenaria*. In these parts of the Culbins it generally occurs alone, and its typical mode of growth is very clearly seen—the long rows, often bifurcating, crossing and intercrossing, of the shoots which rise in succession along the underground creeping rhizomes. This sedge also plays a dominant part on the spaces of low elevation where shifting dune merges into fixed dune, and on sand which has not yet quite lost its mobility, and on sand which has reacquired it. It is also locally dominant on the borders of the "open" fixed dune and that more "closed" with vegetation.

Juncus squarrosus is another locally dominant member of the fixed dune flora, and the other representative plants are similar to those most generally characteristic of the fixed dune flora in the Findhorn Bay Margin area.

On the extreme east of the Culbin Sandhills, just to the west of the Binsness pine wood, much denudation has taken place, as evidenced by the exposed roots of *Calluna* and rhizomes of *Carex arenaria*. Low ridges of sand are being piled up just within the border of the wood. At some parts near here, however, the surface of the low dunes is being covered again with sand. Partial binding is supplied by low mounds of *Calluna vulgaris*, by *Salix repens*, by *Cladonia rangiferina*, and *Cladonia coccifera*, (Linn.), Willd. The *Salix repens* is here much attacked by

a gall, which causes many large scarlet excrescences. Scattered individuals of *Viola canina*, *Galium verum*, and *Taraxacum officinale* are found on the slopes where these fixed or partly fixed dunes rise to windward into shifting dunes.

REVERSED SEQUENCE. — The usual sequence on the Culbin Sands, passing from the sea-coast inland, is: *Ammophila arenaria* on the shifting dunes; then *Carex arenaria* and *Juncus squarrosus* on the more settled sand; *Erica cinerea* and *Calluna vulgaris* on the quite fixed dunes; then, say, *Betula tomentosa* on the dune-marshes. But near the shore of the Moray Firth, between the "Bar" and "Buckie Loch," Mr. R. C. Davie tells us there is an example of a reversal of this general sequence. *Betula tomentosa* grows quite close to the sea; next, to landward, are *Erica cinerea* and *Calluna vulgaris*; then is found *Juncus squarrosus*; then *Carex arenaria*; and lastly *Ammophila arenaria*. This occurs on the flat seaward portion of the dune remains, from which all movable sand has been blown away.

3. Dune-Marshes.

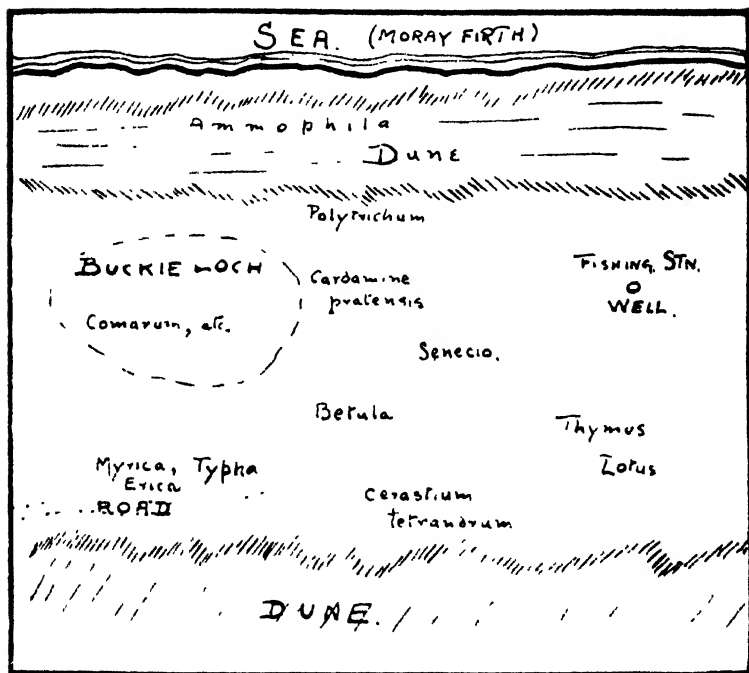
If true littoral salt-marsh is to be found only at Findhorn Bay, inland dune-marsh is less local in occurrence. These marshes lie on all four sides of the high "white" dunes of the Culbin Sandhills proper. For the most part these low-lying areas offer a more or less dry surface in August; but in the wet seasons they vary from marshes to rather extensive though shallow lochs. One, at least, of them is shown on maps as a loch. In every case their flora is at all seasons indicative of a marshy or, at any rate, a moist habitat.

The flora of these "lochs" will be sufficiently exhaustively treated if that of the four most important is dealt with. These lie roughly at the four points of the compass relatively to the Culbin Sandhills proper. They are:—

- (a) Buckie Loch, on the north, the largest.
- (b) West Loch Basin, containing several sheets of water.
- (c) East Loch.
- (d) South Loch.

(a) *Buckie Loch*. (See Map V.)

Buckie Loch is separated from the Moray Firth on the north by a fringe of rather high coastal dunes already mentioned in connection with the Marram grass. The loch lies in a broad valley which is parallel to the dune, is about a mile long, extends westward into the low-lying



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MAP V.

Map showing distribution of vegetation in Buckie Loch and neighbourhood.

sand near the seashore—part, at any rate, of the “Loch” seems to be subject to invasion by high tides,—and is flanked on the south by comparatively low dunes and ridges bearing *Ammophila arenaria*, which rise into the lofty barren dunes. By the early autumn Buckie Loch has diminished in size very considerably; but the gentle marginal slopes which are flooded in the spring bear a dense vegetation. At Buckie Loch there is no great quantity of sand blown in from the west, so that the

vegetation has gained the mastery over a large area, for the time being, at least.

DUNE GRASSLAND.—A dune-grassland-like, close and varied vegetation occurs in this area, especially to the east of the loch proper. Grasses grow luxuriantly, the chief being *Holcus mollis*, Linn.; *Holcus lanatus*, Linn.; and *Aira*, spp. Here *Thymus Serpyllum*, Linn., is subdominant, and *Lotus corniculatus* grows in great abundance with *Viola canina*; *Myosotis versicolor*, Sm.; *Veronica officinalis*; *Senecio Jacobaea*; *Bellis perennis*; *Statice maritima*; *Luzula campestris*; *Taraxacum palustre*, DC.; *Cardamine pratensis*, Linn.; *Polygala vulgaris*, Linn.; *Plantago lanceolata*; *Potentilla Anserina*; *Erophila verna*, E. Meyer; and *Viola palustris*, Linn. Where the vegetation grows up on to the surrounding dunes, *Filago germanica* is frequent.

Within the marginal belt of the loch is a dense marsh of *Potentilla palustris*, Scop. The vegetation about this part has assumed the nature of a felt from out of which the inflorescences of the following species rise: *Eriophorum vaginatum*, Linn.; *Eriophorum angustifolium*, Roth.; *Epilobium palustre*, Linn.; *Galium verum*; *Galium palustre*, Linn.; *Galium uliginosum*, Linn.; *Myosotis scorpioides*, Linn.; *Salix aurita*; *Cardamine pratensis*; *Trifolium pratense*, Linn.; *Drosera rotundifolia*, Linn.; *Caltha palustris*, Linn.; *Senecio Jacobaea*; *Prunella vulgaris*, Linn.; *Viola palustris*; *Veronica scutellata*, Linn.; *Pedicularis palustris*, Linn.; *Pedicularis sylvatica*, Linn.; *Iris Pseudacorus*, Linn.; *Juncus effusus*, Linn.; *Eleocharis palustris*, Roem. et Schult.; *Carex Goodenowii*; *Equisetum limosum*, Linn.; *Ranunculus repens*, Linn.; *Viola canina*; *Spiraea Ulmaria*, Linn. Although the above is roughly the order of frequency of general occurrence, it will be seen by the map that certain are dominant locally.

Associated with these angiosperms are *Philonotis fontana*, Brid.; *Plagiothecium denticulatum*, B. et S.; and *Ceratodon purpureus*.

Low-growing *Betula tomentosa* is frequent along the south-eastern margin.

On the south is a dense mass of *Phragmites communis*, Trin., and another of *Typha latifolia*, Linn.

Hydrocotyle vulgaris, Linn., grows all around the loch.

To the south-west in the valley the ground becomes drier and more and more composed of pure sand. One small damp patch has *Myrica Gale*, Linn., dominant and associated with *Rosa*, sp.; *Valeriana officinalis*, Linn., and *Plantago lanceolata*.

Alnus rotundifolia and *Calluna vulgaris* are associated a drier habitat.

Erica Tetralix is locally dominant with various associates.

Carex Goodenowii and *Teucrium Scorodonia*, Linn., are abundant on the more or less open vegetation of the sand. *Potentilla Anserina*; *Achillea Millefolium*, Linn.; *Vicia angustifolia*, Linn., are frequent. *Scabiosa Succisa*, Linn.; *Pyrola media*; *Luzula sylvatica*, Gaud., also occur. *Polytrichum commune* is dominant in many situations. *Lycopodium clavatum*, Linn., is locally abundant.

(b) *West Loch Basin.*

This is south-of-west from Buckie Loch and just outside the western end of the valley in which the latter lies. The elevation of the sands around is low. About the lochs proper are bogs and marshes like moss-hags, among which are mingled low ridges and flats of fixed and also of shifting sand. On the sandy outskirts on the north side are *Ulex europaeus*, Linn., growing in low mats: and low-growing *Betula tomentosa*. *Salix repens* stretches out on to the sands on all sides. *Equisetum arvense*, Linn.; *Taraxacum officinale*; *Veronica officinalis*; *Viola canina*; *Cardamine pratensis*, also occur. *Carex Goodenowii*; *Hylocomium triquetrum*; *Hylocomium squarrosum*; *Hypnum cupressiforme*; *Brachythecium purum*, Dixon, largely appropriate the sand about the marshes. Numerous sudden changes in the flora are seen in this region, in accordance with the intimate mixture of marshy and sandy habitat.

Blechnum Spicant, With., grows on the sides of the sandy ditches and mounds, *Spiraea Ulmaria* by the bog edges, *Equisetum arvense* in the bogs.

In the water are *Typha latifolia*; *Hippuris vulgaris*, Linn.; *Lemna minor*, Linn.

[On the dry banks near the marsh are *Cytisus scoparius*; *Luzula multiflora*, DC.; *Empetrum nigrum*, Linn.:

Eriophorum vaginatum; and *Lycopodium clavatum*. Associated with the broom on low, dry patches of sand are mats of *Calluna vulgaris*, and *Cladonia rangiferina* spreads over the surface. Another grouping on the dry sand is of *Calluna vulgaris*, dominant, with *Aira caryophylla*, Linn.; *Cladonia rangiferina*; and one or two plants of *Listera cordata*, Br.]

In one of the largest lochs proper the following plants occur: *Potamogeton polygonifolius*, Pourr.; *Equisetum limosum*; *Myriophyllum*, sp.; and *Ranunculus Lingua*, Linn.; and around the margin grow *Caltha palustris*; *Cardamine hirsuta*, Linn.; *Rumex crispus*, Linn.; *Galium palustre*; and *Hydrocotyle vulgaris*.

(c) *East Loch.*

This is a large space among the dunes which decline in height from the high white dunes to Binsness Wood, and which bear *Ammophila arenaria* on their ridges. A variable part of the hollow is covered with water, the rest is sandy but affording a somewhat moist habitat. Among its rich and varied flora, *Littorella uniflora* occurs in great stretches on the wetter ground. *Ranunculus Flammula*, Linn.; *Viola palustris*; *Antennaria dioica*, Gaertn.; *Myosotis caespitosa*, Schultz; *Veronica Beccabunga*, Linn., are also abundant. Mosses form an exceptionally important feature of the arenarial carpet, including *Bryum pseudo-triquetrum*, Schwgr.; *Polytrichum aloides*, Hedw.; *Polytrichum commune*; *Brachythecium albicans*, B. et S.; *Hypnum Schreberi*, Willd.; *Philonotis fontana*; *Aulacomnium palustre*, Schwgr.; and *Ceratodon purpureus*.

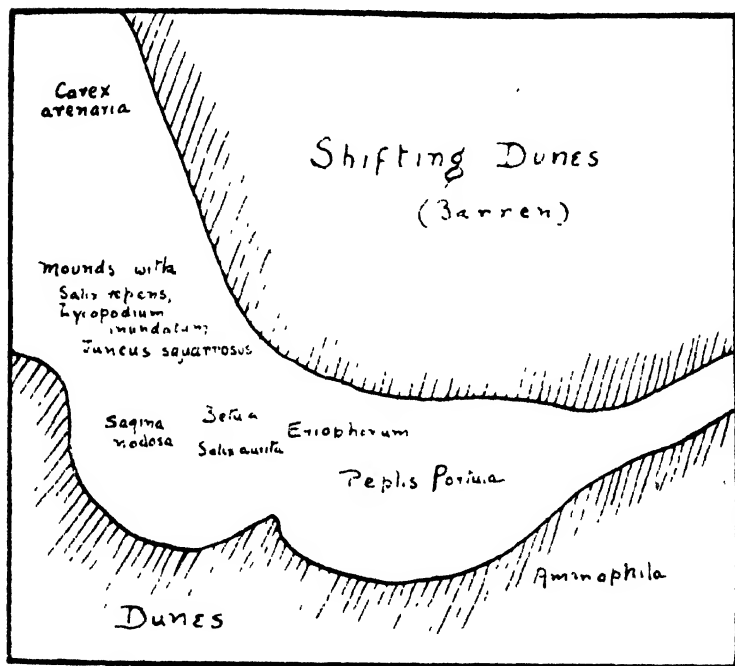
(d) *South Loch.* (See Map VI.)

The driest of the so-called lochs is that on the south-east of the high barren dunes. As early as April the water is fast disappearing and by August the flora and the midges are the only indications that a loch or even a marsh has existed here the same season. The landward boundary of the dunes is not far off.

On the south of the area is a high ridge of sand behind which a flat well covered with vegetation—e.g. *Salix repens*; *Erica cinerea*; *Erica Tetralix*; *Filago germanica*; and

Senecio Jacobaea—extends to the marginal belt of pine wood.

The eastern part of the flat space in which the last of the winter's accumulation of water lingers is just showing in April, at the edge of the retreating pool, young plants of *Peplis Portula*, Linn.; in August the whole of the east end of the space is red with an absolutely pure covering of this



D. P. et E. S. del

MAP VI.

Map showing distribution of vegetation in "South Loch" area.

plant. The first view from the ridge on the south at once suggested to the authors the name "*Peplis Loch*" for the area.

To the west of the water-purslane is a more varied vegetation of a taller growth. *Betula tomentosa* and *Salix aurita* are common here, and round the winter margins of the loch *Peplis Portula* again appears. In this habitat it is greener and taller, growing, as it does, under the shelter of *Juncus effusus* and *Eriophorum vaginatum*. Other plants of this area are: *Ranunculus Flammula*; *Cer-*

astium viscosum, Linn.; *Sagina procumbens*, Linn.; *Sagina nodosa*; *Potentilla Anserina*; *Galium palustre*; *Bellis perennis*; *Senecio Jacobaea*; *Cnicus lanceolatus*, Willd.; *Erica cinerea*; *Erica Tetralix*; *Myosotis palustris*; *Prunella vulgaris*; *Rumex Acetosella*; *Filago germanica*; and *Radiola linoides*. In the damper places *Hydrocotyle vulgaris* is common, so are *Carex Oederi*, Retz.; *Drosera rotundifolia*; *Eriophorum angustifolium*; *Juncus squarrosus*; *Eleocharis palustris*; and *Polytrichum commune*.

The photograph (Plate LVII) shows the luxuriant growth of one of the clumps of cotton grass in the central area where the vegetation is densest.

This loch, like Buckie Loch, is a favourite collecting ground for entomologists, and the relations of the larvae and other stages of the insects, some of them rare, with the vegetation of the most densely grown parts, suggest studies of interest to the botanist.

On the drier outskirts of the marsh are found *Carex arenaria* in abundance, occasional *Cnicus pratensis*, Willd., and much of the fungus, *Lachnea hirta* (Schum.), Gillet.

In some ways the most notable plant obtained in South Loch is *Lycopodium inundatum*, Linn. Here it grows at the bases of little mounds which appear scattered over the transitional space to fixed dune, and just where the darker and damper sand passes into the whiter sand that crowns the mound. The vegetation on the top of the mound is usually close-growing *Salix repens*; *Sagina nodosa*; and *Rumex Acetosella*.

Distribution of the Flora in Area of the Culbin Sandhills Proper. (See Map II.)

Lines drawn across the plan of the Culbins reveal interesting transitions in the flora. One drawn from the sea, north of Buckie Loch, passes over white dune, with *Ammophila arenaria*, through dune-marsh flora, a dune-grassland, or dune-pasture flora, and the various comminglings of these with floras of fixed and shifting dunes about Buckie Loch; then in one direction over bare shifting dune, or dune with *Ammophila arenaria*, to the South Loch with its mingling of typical marsh with drier floras; then to shifting dune and grey dune carrying *Ammophila*

arenaria, and *Erica cinerea* and *Erica Tetralix*; then to the planted defining pine woods, and the fertile fields beyond with characteristic east-coast weeds of pasture and cultivated land. A more easterly line from Buckie Loch passes over shifting dunes, gravel, and fixed-sand plains, scattered growth of *Ammophila arenaria*, *Carex arenaria*, and a few other plants; through East Loch, with flora in more "open" formation and with mosses much more dominant than in Buckie, West and South Lochs; then to the birch wood, partly planted, to grey dune with numerous species holding local dominance, to the flats with somewhat similarly constituted flora and merging into salt-marsh. A line, taking a more northerly course, reaches the planted Binsness pine wood just where the sand, falling in elevation from the high dunes, is partially bound and being bound with *Calluna vulgaris* and other plants, and is partially suffering denudation.

C. MAVISTON SANDHILLS.

1. *Fixed Dunes.*

On the western area of the Culbin region, in its wider sense, the accumulations of sand for a considerable distance inland from the seashore are low and pretty well clothed with *Ammophila arenaria*, and other plants characteristic of even more stable conditions. On the more level portions *Erica cinerea* is dominant, increasing to the westward, where, beyond the sands, a wide, marshy, heathy flat extends towards Nairn.

Vaccinium Vitis-Idaea, Linn., is dominant on a stretch of fairly level fixed sand not far from the shore. Not only does it almost exclusively cover the sand with extensive patches, but from it come the innumerable seeds and coloured stains scattered all over the surface, which represent fruits that have been eaten by birds.

2. *Shifting Dunes.*

On the south-west and landward side of this region rise the Maviston Sandhills proper. These dunes have been for many years, and are still, moving steadily forward and inland. The more level sand on the windward side is being

denuded. A tree of *Alnus rotundifolia* breaks the barren stretch of rather level sand near the rear base of the chief dune; the lower part of this tree has become exposed by the removal of sand which had previously blown over the roots and lower trunk.

The dune is moving uninterruptedly into the great pine forest which was planted to confine the area of sandhills.¹ Every year more trees are engulfed from the wood's margin for the time being. For the original edge has long ago disappeared. The trees which have already been drowned by the wave of sand reappear on its rear slope as the ridge advances, and all that slope is dotted with the black trunks of ruined pines. Some stand erect at the foot of the hill, but are like paper in consistency; a pull suffices to topple over the trunk, perhaps ten feet high and a foot or more in diameter. Higher up the slope more and more of the bole is covered. No fungi or other plants grow on the slope. Fig. 2, *a* and *b*, suggests the form and mode of advance of the dune.

On the plateau-like summit branches appear as if lying unattached in the surface sand; they are really attached to trees standing hidden in the dune. Tops also appear with branches bearing withered leaves, even cones. Tufts of *Ammophila arenaria* grow here and there beside these projecting branches—the only truly living flora of the dune.

On the landward slope the process of engulfing is seen actually going on, as shown in the accompanying photograph (Plate LVII). This slope is steep, the form of the dune being a reversed crag-and-tail. Branches project, or nearly whole trees, according to the position on the slope and the position of the trees with reference to the line of the dune's advance into the wood. Even in those pines, well buried near the crest of the dune, the leaves are still fresh and green, and numbers bear still unopened cones, even cones of the current year.

On the floor of the wood the loose sand extends for a short distance beyond the clearly marked base of the straight front slope. On this new soil grow *Carex arenaria* and *Juncus squarrosus*, like an advance-guard of the invasion of the forest.

¹ Bain, The River Findhorn, pp. 241-242.



Cotton grass, South Loch.



D. Patton, photo.

Advancing face of Maviston Sandhill.

CONCLUSION.

Impressive features of the Culbin Sands, as compared with other dunes which the authors have visited, are:—

1. The variety of the associations in different parts of it; the marked way in which these differently composed floras merge into each other; the equally marked way in which, at other points, they suddenly meet; the frequency with which one passes, when moving in the same direction, through a transitional series from one association to another, and then through the same series reversed.

2. The remarkable richness of species in such comparatively small and isolated localities as the dune-marshes.¹

3. The obvious instability of the conditions. The sequences and reversed sequences not only hold from place to place, but in the same place from time to time. Spots a short distance apart will show successive stages from the beginning of fixation of sand to its complete covering with vegetation; they will also show the stages in the opposite process, stages which suggest that at any time the process going on at a point, whether of progression to a richer flora or to complete barrenness again, may be reversed.

We are much indebted for help in the identification of the mosses to Mr. J. C. Adam.

LIST OF PLANTS NOTED ON CULBIN SANDS.

PHANEROGAMS AND VASCULAR CRYPTOGAMS.

Ranunculus Flammula, Linn.; *R. Lingua*, Linn.; *R. repens*, Linn.; *Caltha palustris*, Linn.

Cardamine pratensis, Linn.; *C. hirsuta*, Linn.; *Erophila verna*, E. Meyer; *Brassica arvensis*, O. Kuntze; *Capsella Bursa-pastoris*, Medic.

Viola palustris, Linn.; *V. canina*, Linn.

Polygala vulgaris, Linn.

Lychnis alba, Mill.; *L. dioica*, Linn.; *Cerastium tetrandrum*, Curt.; *C. viscosum*, Linn.; *C. vulgatum*, Linn.; *Sagina procumbens*, Linn.; *S. nodosa*, Fenzl.

¹ Ewing remarks on the relative poverty of the Culbins in xerophytes and richness in mesophytes—The Flora of the Culbin Sands, p. 11.

Radiola linoides, Roth.

Ulex europaeus, Linn.; *Cytisus scoparius*, Link.; *Trifolium pratense*, Linn.; *T. repens*, Linn.; *Lotus corniculatus*, Linn.; *Vicia angustifolia*, Linn.

Spiraea Ulmaria, Linn.; *Potentilla erecta*, Hampe; *P. Anserina*, Linn.; *P. palustris*, Scop.; *Alchemilla arvensis*, Scop.; *Rosa canina*, Linn.

Drosera rotundifolia, Linn.

Hippuris vulgaris, Linn.; *Myriophyllum*, sp.

Peplis Portula, Linn.

Epilobium palustre, Linn.

Hydrocotyle vulgaris, Linn.

Sambucus nigra, Linn.

Galium verum, Linn.; *G. saxatile*, Linn.; *G. palustre*, Linn.; *G. uliginosum*, Linn.

Valeriana officinalis, Linn.

Scabiosa Succisa, Linn.

Bellis perennis, Linn.; *Aster Tripolium*, Linn.; *Filago germanica*, Linn.; *Antennaria dioica*, Gaertn.; *Achillea Millefolium*, Linn.; *Chrysanthemum segetum*, Linn.; *C. Leucanthemum*, Linn.; *Senecio Jacobaea*, Linn.; *Cnicus lanceolatus*, Willd.; *C. pratensis*, Willd.; *Hieracium corymbosum*, Fr.; *Taraxacum officinale*, Weber; *T. palustre*, DC.; *Sonchus asper*, Hill.

Vaccinium Vitis-Idaea, Linn.

Calluna vulgaris, Hull; *C. vulgaris*, var. *pubescens*, Hull; *Erica Tetralix*, Linn.; *E. cinerea*, Linn.; *Pyrola media*, Sw.

Statice maritima, Mill.

Glauz maritima, Linn.

Centaurium vulgare, Rafn.

Lycopsis arvensis, Linn.; *Myosotis scorpioides*, Linn.; *M. caespitosa*, Schultz.; *M. versicolor*, Sm.

Solanum Dulcamara, Linn.

Veronica serpyllifolia, Linn.; *V. officinalis*, Linn.; *V. Chamaedrys*, Linn.; *V. scutellata*, Linn.; *V. arvensis*, Linn.; *V. Beccabunga*, Linn.; *Euphrasia officinalis*, Linn.; *Pedicularis palustris*, Linn.; *P. sylvatica*, Linn.

Pinguicula vulgaris, Linn.

Thymus Serpyllum, Linn.; *Prunella vulgaris*, Linn.; *Teucrium Scorodonia*, Linn.

Plantago lanceolata, Linn.; *P. Coronopus*, Linn.; *Littorella uniflora*, Aschers.

Atriplex patula, Linn.

Polygonum Convolvulus, Linn.; *P. Persicaria*, Linn.; *Rumex crispus*, Linn.; *R. Acetosa*, Linn.; *R. Acetosella*, Linn.

Urtica dioica, Linn.

Myrica Gale, Linn.

Betula tomentosa, Reith. et Abel; *Alnus rotundifolia*, Mill.

Salix aurita, Linn.; *S. repens*, Linn.

Empetrum nigrum, Linn.

Pinus sylvestris, Linn.

Listera cordata, Br.; *Goodyera repens*, Br.

Iris Pseudacorus, Linn.

Juncus squarrosus, Linn.; *J. effusus*, Linn.; *Luzula sylvatica*, Gaud.; *L. campestris*, DC.; *L. multiflora*, DC.

Typha latifolia, Linn.

Lemna minor, Linn.

Triglochin maritimum, Linn.; *Potamogeton polygonifolius*, Pourr.

Eleocharis palustris, Roem. et Schult.; *Scirpus setaceus*, Linn.; *Eriophorum vaginatum*, Linn.; *E. angustifolium*, Roth.; *Carex arenaria*, Linn.; *C. leporina*, Linn.; *C. Goodenowii*, Gay.; *C. Oederi*, Retz.

Ammophila arenaria, Link.; *Aira caryophylla*, Linn.; *A. praecox*, Linn.; *Holcus mollis*, Linn.; *H. lanatus*, Linn.; *Phragmites communis*, Trin.; *Poa annua*, Linn.

Blechnum Spicant, With.

Equisetum arvense, Linn.; *E. limosum*, Linn.

Lycopodium inundatum, Linn.; *L. clavatum*, Linn.

MOSSES.

Aulacomnium palustre, Schwgr.

Brachythecium albicans, B. et S.; *B. purum*, Dixon.

Bryum pseudo-triquetrum, Schwgr.; *Bryum*, sp.

Ceratodon purpureus, Brid.

Hylocomium squarrosus, B. et S.; *H. triquetrum*, B. et S.

Hypnum cupressiforme, Linn.; *H. Schreberi*, Willd.

Philonotis fontana, Brid.

Plagiothecium denticulatum, B. et S.

Polytrichum aloides, Hedw.; *P. commune*, Linn.

Thuidium tamariscinum, B. et S.

LICHENS.

Cladonia coccifera (Linn.), Willd.; *C. pyxidata*, Fr.; *C. rangiferina*, Nyl.

Peltigera canina, Hoffm.

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WILLIAM ARTHUR, M.D., BOTANIST TO THE KING IN
SCOTLAND, 1715-1716. By Professor BAYLEY BALFOUR,
F.R.S.

(Read 12th November 1914.)

Some years ago I presented to the Society a short history of the Royal Botanic Garden, of its Regius Keepers and of its Principal Gardeners, which has been the basis of the historic sketch which appears in the small guide for the use of visitors to the Garden. One interesting fact discovered in the course of the investigation for the preparation of the story was that the name of a Professor of Botany who was Regius Keeper had been dropped entirely from the published record. In the sketch which I present now I have brought together all the facts I have been able to gather regarding this Professor—Dr. William Arthur.

A septuagenarian numismatist, as was James Sutherland, King's Botanist, Regius Keeper of the Royal Botanic Garden, and Professor of Botany, at the close of the reign of Queen Anne, is not the person likely to be selected, if choice were offered, for the post of administrator of a Botanic Garden in which a collection of living plants had to be maintained on scientific lines up to date, nor is it likely that a course of instruction in Botany to youth would be efficiently carried on under a teacher of this description. It is not surprising, therefore, that on the accession of King George I the office of King's Botanist, with care of the Royal Physic Garden—a Household appointment, and therefore held only during pleasure,—which Sutherland had filled during the two preceding reigns, was not conferred upon him. The needs of political patronage probably operated in the direction of encouraging a change of personnel, but on the facts, even if Sutherland were not acquiescent in the change, it can hardly be protested that the time had not arrived when a new appointment was imperative.

The new appointment was not, as it happened, an advantage either to the Garden or to the teaching. We are introduced—as the warrant I transcribe here tells—to the name of Dr. William Arthur:—

"Dr. Arthur, Botanist, 28th July 1715.

"George &c. fforasmuchas Wee Considering yt. it is necessary that the physick Garden at the palace of Holyrood house be kept in good order and for that effect that all due Encouragement be given to a person skilled in Botany who may have the Inspection of the said Garden and may be oyrwise usefall to the lieges by Instructing them in the usefall Science of Botany And we being well Informed of the good Qualifications of Mr. Wm. Arthur, Dr. of Medicine as to his fitness for the office of Botanist and of his good affection to us and our Government Therefor witt ye us with the advice and Consent of the Lord Chiefe barron and remanent Barrons of our Exchequer in Scotland to have made Constituted and appointed Like as Wee by those presents Make Constitute and appoint the Said Mr. Wm. Arthur During our pleasure only to be our botanist within that part of our Said kingdom And Wee Give and grant unto him the oversight care and inspection of our said physick garden to the effect he may keep the Same in good Order With power to him to Sett up a profession of Botanic and materia medica and to Teach the Same and to have and Enjoy the haille fees Casualties priveleges and Immunities of the said office as fully and freely as the Same was possessed by Mr. James Sutherland heretofore And for the said Mr. Wm. Arthur his further encouragement Wee have given and Granted and hereby Give and grant to him During the Space forsaid the yearly Sallary of fifty pounds Sterling monie to Commence from the 25 day of March 1715 years and So furth thereafter to Continue During our pleasure as said is Given at our Court at St. James's and under our privy Seale of Scotland the 10th day of May 1715 in the first year of our reigne.

"Per Signaturam Signo manu Q.D.M. Regis Suprascript.

"Manibusque Barrons. Scaccarii Scoticae subscript."

Of Dr. William Arthur information will be sought in vain in any botanical book. Not only this, but historians of the Botanic Garden and of botanical education in Edinburgh have failed to take account of any King's Botanist and Custodian of the Garden between the tenancies of James Sutherland and Charles Alston—the

date of the warrant appointing the latter being 30th June 1716. The short period of some thirteen and a half months covers that of Arthur's official life, and during it I imagine he performed few or none of its professional or other administrative duties, and the silence of botanical tradition is therefore readily accounted for.

But if Dr. William Arthur is unknown as an exponent of Botany and is unnamed in botanical history as a teacher and administrator, he is not without claims to notoriety, for the Professor became a political conspirator, and is no other than the physician in Edinburgh through whom, according to the historians, the Jacobite plot to capture the Castle of Edinburgh in 1715 was brought to disaster. From the published accounts of this enterprise I select to reproduce here for the purposes of my narrative of Dr. William Arthur the story as given by Sir Walter Scott in *Tales of a Grandfather*:—¹

"James Lord Drummond, son of that unfortunate Earl of Perth, who, having served James VII as Chancellor of Scotland, shared the exile of his still more unfortunate master, and been rewarded with the barren title of Duke of Perth, was at present in Edinburgh; and by means of one Mr. Arthur, who had been formerly an ensign in the Scots Guards, and quartered in the Castle, had formed a plan of surprising that inaccessible fortress, which resembled an exploit of Thomas Randolph, or the Black Lord James of Douglas, rather than a feat of modern war. This Ensign Arthur found means of seducing, by money and promises, a sergeant named Ainslie, and two privates, who engaged, that, when it was their duty to watch on the walls which rise from the precipice looking northward, near the sally-port, they would be prepared to pull up from the bottom

¹ The story will be found elsewhere with varying details in:—

MEMOIRS of the life of Sir John Clerk of Penicuik, Baronet.

Edited by John M. Gray for the Scot. Hist. Soc., 1892.

JOHN, MASTER OF SINCLAIR. *Memoirs of the Insurrection in Scotland in 1715.*

PATTEN. *History of the Rebellion in the Year 1715.* 3rd ed., p. 135.

RAE. *History of the late Rebellion, 1718.*

MAHON. *History of England from the Peace of Utrecht to the Peace of Aix-la-Chapelle*, vol. i (1836), p. 220.

HOGG. *The Jacobite Relics of Scotland, 1821*, p. 230.

GRANT. *Old and New Edinburgh*, vol. i, p. 67.

certain rope ladders prepared for the purpose, and furnished with iron grapplings to make them fast to the battlements. By means of these, it was concluded that a select party of Jacobites might easily scale the walls, and make themselves masters of the place. By a beacon placed on a particular part of the Castle, three rounds of artillery, and a succession of fires made from hill to hill through Fife and Angus shires, the signal of success was to be communicated to the Earl of Mar, who was to hasten forward with such forces as he had collected, and take possession of the capital city and chief strength of Scotland.

"There was no difficulty in finding agents in this perilous and important enterprise. Fifty Highlanders, picked men, were summoned up from Lord Drummond's estates in Perthshire, and fifty more were selected among the Jacobites of the metropolis. These last were disbanded officers, writers' clerks and apprentices, and other youths of a class considerably above the mere vulgar. Drummond, otherwise called MacGregor, of Bahaldie, a Highland gentleman of great courage, was named to command the enterprise. If successful, this achievement must have given the Earl of Mar and his forces the command of the greater part of Scotland, and afforded them a safe and ready means of communication with the English malecontents, the want of which was afterwards so severely felt. He would also have obtained a large supply of money, arms, and ammunition deposited in the fortress, all of which were most needful for his enterprise. And the apathy of Lieutenant-Colonel Stewart, then Deputy-Governor of the Castle, was so great that, in spite of numerous blunders on the part of the conspirators, and an absolute revelation on the subject made to Government, the surprise had very nearly taken place.

"The younger conspirators who were to go on this forlorn hope, had not discretion in proportion to their courage. Eighteen of them, on the night appointed, were engaged drinking in a tippling-house, and were so careless in their communications, that the hostess was able to tell some person who inquired what the meeting was about, that it consisted of young gentlemen who were in the act of having their hair powdered, in order to go to the attack of

the Castle. At last the full secret was entrusted to a woman. Arthur, their guide, had communicated the plot to his brother, a medical man, and engaged him in the enterprise. But when the time for executing it drew nigh, the doctor's extreme melancholy was observed by his wife, who, like a second Belvidera or Portia, suffered him not to rest until she extorted the secret from him, which she communicated in an anonymous letter to Sir Adam Cockburn of Ormiston, then Lord Justice-Clerk, who instantly dispatched the intelligence to the Castle. The news arrived so critically, that it was with difficulty the messenger obtained entrance to the Castle; and even then the Deputy-Governor, disbelieving the intelligence, or secretly well affected to the cause of the Pretender, contented himself with directing the rounds and patrols to be made with peculiar care, and retired to rest.

"In the meantime, the Jacobite storming party had rendezvoused at the churchyard of the West Kirk, and proceeded to post themselves beneath the Castle wall. They had a part of their rope ladders in readiness, but the artificer, one Charles Forbes, a merchant in Edinburgh, who ought to have been there with the remainder, which had been made under his direction, was nowhere to be seen. Nothing could be done during his absence; but, actuated by their impatience, the party scrambled up the rock, and stationed themselves beneath the wall, at the point where their accomplice kept sentry. Here they found him ready to perform his stipulated part of the bargain, by pulling up the ladder of ropes which was designed to give them admittance. He exhorted them, however, to be speedy, telling them he was to be relieved by the patrol at twelve o'clock, and if the affair were not completed before that hour, that he could give them no further assistance. The time was fast flying, when Bahaldie, the commander of the storming party, persuaded the sentinel to pull up the grapnel, and make it fast to the battlements, that it might appear whether or not they had length of ladder sufficient to make the attempt. But it proved, as indeed they had expected, more than a fathom too short. At half-past eleven o'clock, the steps of the patrol, who had been sent their rounds earlier than usual, owing to the message

of the Lord Justice-Clerk, were heard approaching, on which the sentinel exclaimed, with an oath, 'Here come the rounds I have been telling you of this half-hour; you have ruined both yourself and me; I can serve you no longer.' With that he threw down the grappling-iron and ladders, and, in the hope of covering his own guilt, fired his musket, and cried 'Enemy!' Every man was then compelled to shift for himself, the patrol firing on them from the wall. Twelve soldiers of the burgher guard, who had been directed by the Lord Justice-Clerk to make the round of the Castle on the outside, took prisoners three youths, who insisted that they were found there by mere accident, and an old man, Captain MacLean, an officer of James VII, who was much bruised by a fall from the rocks. The rest of the party escaped amongst the north bank of the North Loch, through the fields called Barefoord's Parks, on which the new town of Edinburgh now stands. In their retreat they met their tardy engineer, Charles Forbes, loaded with the ladders which were so much wanted a quarter of an hour before. Had it not been for his want of punctuality, the information and precautions of the Lord Justice-Clerk would have been insufficient for the safety of the place. It does not appear that any of the conspirators were punished, nor would it have been easy to obtain proof of their guilt. The treacherous sergeant was hanged by the sentence of a court-martial, and the Deputy-Governor (whose name of Stewart might perhaps aggravate the suspicions that attached to him), was deprived of his office, and imprisoned for some time."

That the physician-conspirator of this history is Professor William Arthur, King's Botanist, is established by his own confession, as will appear in the account I now proceed to give of what I have been able to learn about him.

William Arthur was a native of Fifeshire, the fourth son of Patrick Arthur of Ballone, near Elie. He was born in 1680.¹ His father, who was at one time Surgeon-Apothecary at Wemyss, and afterwards settled at Elie, must have

¹ William Arthur, son to Margaret and Patrick Arthur, was baptised 2nd of September 1680—Witnesses, David Leslie, Master of Newark; Dr. William Borthwick. (Baptismal Register, Elie Parish.)

m. Dec. 17, 1673.

(1) Dr. John Gontley, m. 1650.
End son of Sir John
and son of John
of Newcastle.
d. 1687.

(2) Margaret Sharp,
daughter of Dr. Sharp
of Edinburgh. Prob-
ably married at Rile 1687;
d. 1687.

(3) Patrick Arthur
of Ballone, Ruge-
necourt, Wemyss
Apotecary at Wemyss
and afterward at Rile.

John Arthur,
Minister of Abercorn?
Chaplain at Wemyss
and afterward at Rile.
His nephew John.

Agnes Arthur,
unmarried. Festan, Zeln.
Com. 3 Nov 1710; Zeln.
Arthur, wife of German,
settled in Edinburgh,
excellent.

(1) Dr. John Gourlay,
2nd son of Sir John
Gourlay of Kincaig.
Settled at Elie 1687;
d. 1697.

m. Dec. 17. 1672.

John Arthur,
Minister of Abercorn?
Chaplain at Wemyss?
Witness to baptism of
his nephew John

Agnes Arthur,
unmarried, Testam. Edin.
Con., 8 Nov. 1710; Jean
Arthur, sister german,
residenter in Edinburgh,
executrix.

[illegible]1 Dalton. *Army Jists.* v. n 140.

ibid., v. II, 89.

§ Ibid., vi. pp. 10, 62.

CONNECTIONS OF WILLIAM ARTHUR BY HIS MARRIAGE.

= ADAM COCKBURN, = (2) Anne Houston,
 (1) Susanna Hamilton, daughter of Sir Patrick
 of 4th Mar. Bt., of Housaton, d. 1721.
 S.C.J., J.Y.C. d. 1718.

= James Ingalls, husband to
 1st Mar. Bt. of White-
 Grandm., d. 1704
 J.Y.C. d. 1704
 (2nd husband
 to Anne.)

Anne, = JOHN INGLIS,
d. 1772. 2nd Bart. of
Cramond, d.
1771.

Jennet, = JOHN C.
d. 1760 2nd Bar
(2nd wife Pentaulk,
to Clerk). Baron of
chequer.

Margaret Stuart,
D. of Earl of
Falloway. (1st
wife to Clerk).

John Lawson, = Barbara, = WM. A
Barl. of d. 1734. d. 1710.
Calvinist husband
(Asthurst to Barbara).

Margaret = Wm. Aikman
of Cairney,
Advocate, of
Sheriff Forfar-
shire.

Catharine = Sir David Forbes of Newhall.	Robert, b. 1664, d. 1720	John, P.R.C.P.E. 1740.
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Professor BAYLEY BALFOUR,

To face p. 381.

been a man of some position, for he was a Commissioner of Supply for Fifeshire.¹ In view of aspects of our story that will appear later, it is interesting to know that James Cunningham of Barns, a lairdship near Elie, was appointed Commissioner of Supply at the same time as Patrick Arthur. William Arthur's mother, Margaret Sharp,² daughter of Dr. Sharp of Edinburgh, was related to Archbishop Sharp,³ whose daughter Isobel was the wife of John Cunningham of Barns, father of James. The Arthurs and the Cunninghams were therefore not only neighbours but connected by very close family ties. The pedigree table annexed gives such information of the family of Arthur as I have been able to obtain.

The Church, Medicine, and the Army were the vocations that attracted the sons of Patrick Arthur. William Arthur chose Medicine and went to Utrecht, then at the zenith of its reputation under Boerhaave, and obtained the diploma of M.D. there, on 12th March 1707, as we learn from the records of the Royal College of Physicians of Edinburgh, of which incorporation he became in time a Fellow.⁴

I gather that on his return to Scotland William Arthur engaged in medical practice at Elie, probably assisting his father; at least that is the inference I draw from the description of him in the record of Edinburgh marriages.⁵

¹ Scot. Act Parl., August 1707.

² Mr. Patrick Arthur and Margaret Sharp, both in the Parish of Elie, were contracted upon the 7th day of December 1672. They were married upon the 17th of December 1672. (Elie Parish Register.) Margaret Sharp was at the time widow of John Gourlay, second son to Sir John Gourlay of Kimerairg, who had died in 1666 and to whom she was married in 1660.

³ In this connection Wood says in the *East Neuk of Fife*, ed. 2, 1887, p. 202: "In May 1679 the archbishop's daughter, also Margaret Sharp, afterwards Lady Salton, was paying a visit to Dr. Arthur in this house, when the news reached her of the murder of her father on Magus Muir. In her grief and anxiety, she set out without a moment's delay expecting to get at Colinsburgh a conveyance to St. Andrews, and, as tradition says, in order to make more speed, cast off her high-heeled shoes at the 'White Yett' (the old entrance to Elie House, somewhat south of the present one), and performed the rest of her journey on her 'stocking soles.'" (See *Elie Parish Register*. Wood, *East Neuk of Fife*.)

⁴ See copy of the Minute on p. 383.

⁵ The entry runs: "Mr. William Arthur, Doctor of Medicine in Elie Parish, in Fife, and Barbara Clerk, widow of John Lawson of Cairnmore in North-West Parish. Pro. 12th February 1710, M. 21st February 1710."

In support of this I may cite also the fact that his name appears as "of Elie" in documents of the day.¹

At the time of his marriage he could not be a practitioner in Edinburgh, because the privilege of the Royal College of Physicians to grant a licence to practise within the City and liberties of the City of Edinburgh was then strictly reserved, and Arthur had not applied for such a licence, and did not do so until three years later. That he had entry to the leading society in Edinburgh of his day is evidenced by his matrimonial alliance with the family of Clerk of Penicuik, his wife being sister of the distinguished Baron of Exchequer, John Clerk, second Baronet of Penicuik, who was then one of the most influential men in the capital of Scotland. The pedigree table included here shows the connections Arthur established by his marriage, and these have an interesting bearing upon the events I am about to relate. Through this connection, doubtless, we find Dr. Arthur attending the Baron professionally in company with Dr. John Clerk, first cousin of his wife. In his Memoirs² (p. 85) Sir John Clerk says:—

"About the end of June 1713 I caught cold at the pouting on the moors, and fell into a fever, which continued with me for 3 weeks. I was brought very low, but by the will of God and the assistance of Dr. Clerk and Dr. Arthur, two young physicians, I happily recovered. My chief pain and trouble lay in my head, which I found vastly eased by the application of a Blister to my back, and a cataplasim of poppies to my head. I have made a particular journal of my distemper, so shall say no more here."

It was in this year 1713, probably, that Dr. Arthur definitely settled in Edinburgh, for the records of the

¹ My references are mislaid. The following suggests residence:—Precept of Clare Constat by Robert Lundie of that ilk, superior, in favour of Anna, Isobella, Sophia, Margaret, and Mary Lundie, as lawful daughter and nearest heirs of the late James Lundie, for infefting them in the Keirs and Damside and the Mains of Strathairlie, bounded and described as in former writs, No. 2544 and 2626 *supra*, being parts of the lands of Strathairlie.—At Lundin, 5th October 1708. Witnesses, Sir John Inglis of Cramond, Baronet; Mr. William Arthur, M.D.; Humphrey Lundin, Writer in Edinburgh, and others.—The Laing Charters, p. 703.

² Memoirs of the Life of Sir John Clerk of Penicuik. Edited by John M. Gray for the Scot. Hist. Soc., 1892.

College of Physicians show that he then applied for the necessary licence to practise in Edinburgh. By the courtesy of the President and Fellows of the College I am able to quote the following Minute:—

“EDINR., 23rd November 1713.

“Dr. William Arthur’s petition for a tryal.

“The said day the petitione presented to the Colledge by Mr. William Arthure Doctr of Medicine mentioning that he haveing for severall years past applyed himself to the practise of Medicine both at home and abroad, and being graduat Doctr of Medicine at ye University of Utrecht upon the twelft day of March 1701 years as his patent of graduatione produced has expressed and therefor craving that the Colledge would hold the ordinary tryall of his qualifications to practise Medicine and being found qualified to Licentiat him to practise Medicine within the City of Edinburgh and Liberties thereof which petitione being read heard and considered by the Colledge they grant the Desyre thereof and ordain him to be examined upon the institutione and appoynts Doers. Crawford and Montgomery to Examination yrupon at any Dyet the President shall acquaint them with. The said Dr. Arthure haveing payed the Thesauror ane hundred merks gross in part of his Dues as a Licentiat and Lykewayes satisfied ye Clerk and officer.

“MATTHEW ST. CLAIR,

“P.C.R.M.E.

“5th Jany. 1714.—Dr. Arthur examd. upon the Institutions.

“19th Jany. 1714.—Dr. Arthur explained two aphorisms.

“9th Feby. 1714.—Dr. Arthur admitted as licentiate.

“1st June 1714.—Dr. Arthur admitted Fellow.”

We picture Arthur during the years 1713–1715 as a medical practitioner in Edinburgh, associating with the most influential people, many of them his patients, and beyond suspicion of any want of loyalty—against that his wife’s relationships protected him—at a period when the Hanoverian succession was not definitely established, and the prospect of a Stewart return by no means obscured.

There is no suggestion in any mention of him that has yet become known that he had made any particular study of Botany, or that he was more informed about plants for medicinal purposes than the ordinary physician of the day, who had to compound his own drugs, frequently also to grow the plants from which the drugs were obtained. Nevertheless, he was able to procure for himself in March 1715 the Household appointment which had been held by Sutherland and which carried with it the responsibility of keeping the Holyrood Garden and teaching there Botany and *Materia Medica*.

Then came the débacle of the Castle plot in September 1715. The histories say of Arthur that he was a recent convert to the Jacobite cause. This may be true so far as concerns any active share he may have taken in measures for a Stewart restoration, but he came out of a Jacobite nest.¹ His early associations were all with Jacobites. Prudence in relation to material prosperity may have induced dissembling of his real political thoughts, but one must believe that the Jacobite spirit was there, and only dormant until occasion called forth its exercise.

Of the part he played in the carrying out of the scheme of the conspirators we have his own account, written from Rome as a report to the Earl of Mar in 1716. The substance of this has appeared in the *Calendar of the Stuart Papers*, vol. iii, published by the Historical MS. Commission in 1907. In the condensation necessary for its publication

¹ Wood (*East Neuk of Fife*, 2nd ed., 1887, p. 202) says the whole family of Arthur were pronounced Jacobites. We have for this evidence also in the intimacy that existed between the Arthur family and the arch-Jacobite Dr. Patrick Blair. Thus Dr. Patrick Blair writes to Petiver, the distinguished London apothecary:—

“DUNDEE, *November 28, 1713.*

“I cannot express my concern that I have received nothing from you by this ship who has unloaded my drugs this day, especially what belongs to Dr. Arthur with whom I am like to lose credit for having taken his money and he having not yet got any of the effects.”—Sloane MSS. 3321, fol. 52.

And again—

“COUPAR, *February 27, 1714.*

“Dr. Arthur seems to be displeased with the parcel of Books you sent by Falconer. I wish he had got the rest of his copies.”—Sloane MSS. 3321, fol. 64.

The Dr. Arthur referred to is probably Alexander Arthur, brother of the Professor. See the pedigree at p. 381.

there, some personal touches and references to localities are omitted, and these, whilst of less moment to the general reader, are of sufficient local interest to justify printing here a literal transcript. By the graciousness of His Majesty the late King Edward VII, I was granted the privilege of a transcript of the whole MS. which is now in the Library at Windsor, and am allowed to reproduce it.

[DR. ARTHUR TO THE DUKE OF MAR.]

[1716, before October 17.]—"May it please your Grace Its the inseparable Fate of every one concerned in mis-adventures to bear a share of the dishonour however he acquitts himself. Tho' mine have been of such an unhappy nature that they strike at the two prime qualitiys wherein one can be of use in any enterprize his Conduct and Courage the heaviest imputations that can fall upon a Character, yet I had too many Vouchers not to be proof against them had I been able to bear the thought of being consider'd to have had a guilty pairt in the King's misfortunes,¹ the only causes of all my sorrows and any im-

¹ Here we have Arthur defending himself against the accusation of betrayer of the plot. On a later page he returns to this when describing his parting from his wife (see p. 397). The historians have always made an effective use of the episode so gratifying to the instinct of "*cherchez la femme*." That the plot was betrayed from within the body of conspirators is attested by so good an authority as Baron Clerk, whose close relationship to Lord Ormiston, the receiver of the betraying communication, as well as to Dr. Arthur, is shown in the pedigree table at p. 381. In his Memoirs, p. 94, Baron Clerk says:—

"One publick incident I cannot but remember here, because some of my particular Friends were so unhappy as to be concerned in it, this was in September 1715, just after Mar came to Scotland and had begun the Rebellion, to surprise the Castle of Edin.

"As the appointed time drew near for accomplishing this enterprise, I belive some of the intended conquerors began to discover their want of adequet courage, and therefor, to prevent it, made a secret intimation of it to the justice clerk, then Lord Ormiston, he immediately gave notice of it to the Depute Governour, who ordered most of his Garrisone to go the round of the Castle Wall. This precaution hapned precisely in time, for just as the Garisone came to that part of the Wall which was to be scaled they found the above Serjeant Ainsley fixing the Laders. He was immediately apprehended, and on the firing of a musket the Heroes below dispersed themselves. Most of them on this discovery fled the country, and the Serjeant was shortly after hanged at the place where he was taken."

This does not implicate Dr. Arthur directly, and as his brother Thomas Arthur was in the conspiracy, was married, and his wife knew of his Jacobite associations (see p. 390), it may have been, if the betrayer

patience I have ever express't, to which if I had the least contributed I had been so far from ever having the Confidence of putting your Grace in mind of me that I should have counted it my greatest happyness as I would have made it my endeavour to be forgot for ever. And I must confess I had such a reluctance to that infamy which weakness I know your Grace will easily pardon that I was resolv'd as weel as others to doe myself Justice as to those points tho' by way of digression whatever way I was to make my exit out of the world. Your Grace remembers that from time to time we were forc't to alter our first Scheme according to the changes made in the Castle, till at last by confineing the numbers of the visitors there to three only at once we were oblig'd to think on the Scalad. My brother,¹ and I waited on Dr. Smith² severall times for that purpose but he was grown so peevish that his secret had been at first neglected that we could get him to doe nothing. On which there was no time lost to let my Lord Drummond³ know where we stuck who took immediate care to send one who was accounted ane ingenious workman⁴

was an Arthur, and a lady, that it was through Mrs. Thomas Arthur the plot was discovered.

In this connection it may be said also that if the references to "Lady Arthur" in the Ormonde letters (see "The Jacobite attempt of 1719," Scot. Hist. Soc., 1895) are to the Professor's widow, they show that she was a Jacobite and, therefore, that she would not be likely to act in a way that would ruin alike her husband and the cause.

¹ My brother. Thomas, a younger brother. Ensign, Third Regiment of Foot Guards, 14th April 1712; out of regiment 24th March 1714 (see Dalton, vi, pp. 60, 62). Probably the Major Arthur mentioned in Cal. Stuart Papers, iii, pp. 195, 215:—

"William Gordon to John Paterson.

"1716, November 9. Paris.

"I am glad Major Arthur has written. His friends are in great pain about him, for they have had him dead in Scotland as well as his brother."

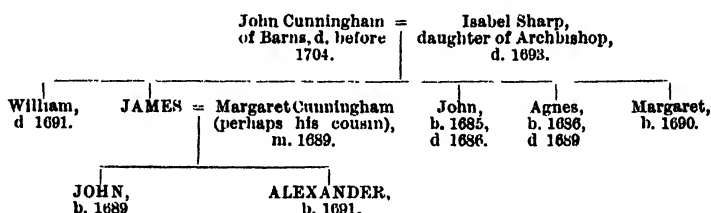
² Dr. Smith. Is this a cypher name? On p. 396 there is a reference to Mr. Smith, which was the cypher name of Lord Stormont.

³ Lord Drummond. James Drummond (1675–1720), afterwards fifth Earl and second titular Duke of Perth.

⁴ "My Lord Drummond, who amongst the many good qualities he has inherited from his familie, has that of imagining nothing can be well done except he has the management of it, would undertake the direction of all; and for that effect made choice of a little broken merchant, Charles Forbes, a man according to his own heart, who was to be principall engineer and conductor of the affair."—Master of Sinclair's Memoir, p. 29.

to whom Barns¹ and my Brother gave the necessary instructions with the greatest exactness allowing severall fathoms in the length to come and goe upon. But he pretending that he cou'd doe the wooden and Iron work better at home tho' my Brother had provided a very convenient house for him of his own, we gave him leave to goe his ways; he promising to return with Mr. Forbes² leaving his directions with us concerning the largeness and length of the Ropes, that he said he cou'd adjust in two hours which very soon after Mr. A.³ took care to provide as likewise to bespeak a very convenient place for him in one Mr. Skeen's howse⁴ a mile from the town and as far from the destin'd place in the Castle. Your Grace knows the design had been long a foot and we not beeing then certain how soon

¹ Barns. Cunningham of Barns (see Patten's History, p. 38). Wood (East Neuk, p. 397) gives the following pedigree of the Barns family:—



This pedigree does not impress me as being correct. If James married in 1689, he would be, say, 21, and therefore born in 1668—but his next brother was born 1685, *i.e.* 17 years after. The Elie registers may decide.

² Mr. Forbes, James Forbes. Cypher names of Captain Henry (Harry) Straton (Stracton, Straiton), one of the most active Jacobites of the period, in the confidence of the Earl of Mar. See many letters and references in the Cal. of the Stuart Papers. He died in 1725. Thus Lockhart to the Pretender.—

"I gave you a few dayes ago an account of H. Straton's death, my letter Dated 8th instant May 1725 went by the common post to Mr. Dundass, because I had no occasion of a ship from Leith and did not incline to lose any time in acquainting you of it: however it was so writ as to be of no consequences if intercepted. In it I told you all his papers were secured; but I am now to inform you that last week his wife, by the advice of Balmerinloch burnt all that had any relation to you or your friends."—Lockhart Papers, ii, p. 154.

It will become apparent in course of Dr. Arthur's narrative that he throws blame for the failure of the conspiracy upon Captain Straton.

³ Mr. A. Who was this? Not his brother Thomas. Perhaps James Arthur of Shanon's Regiment.

⁴ Mr. Skeen's house. The Master of Sinclair says, "They had employ'd a fellow in the Caltone to make the ladders."

the execution¹ might be necessary it was thought proper my Brother and I should make ourselves known to two or three noted torys of generall acquaintance with the youth in town, by which means we found to our satisfaction that in twenty four hours' warning we might command as many² as we needed for any loyall undertaking of that nature in which we acquiesc't without coming to particulars or insisting further at that time. But Shanons Regim[en]t³ arriving it was th'ot better we should have some Souldiers upon which by the advice of Mr. Stracton that we always obtained by Barns's means, and if I be not mistaken my Brother consulted the Earl of Northesk and Leven and my Lord Haddow. We got leave to break our mind sometime after to James Arthur⁴ our Cozen German then a Lieut[enant] in the fores[a]id regim[en]t, who at lenth undertook to provide us with forty Grenadiers upon demand with their arms and ammunition, by which means we knew how to make up the Complement with the assistance of twenty

¹ Col. Allan Cameron in the narrative of "his going into England from the King, July 1715, which he wrote at Avignon from memory & gave Lord Mar 29 October 1716," mentions amongst the instructions he communicated to the King's friends this one, that if Government attempted to disarm or arrest them before the King set out for Scotland they should "put all their schemes of surprising Edinburgh Castle & other places in execution."—Cal. Stuart Papers, iii, p. 558.

Again on p. 559: "I had on my arrival at London two letters from my nephew who waited on you at Nancy. He had been amongst your friends and gave a full account that all things there were then in readiness and every one concerned had acted their part so well that their schemes were then ready for execution and that there seemed to be no fear of their miscarrying, and that Lord Marischal had prepared everything that could be done at Dunottar and Edinburgh Castle and other places there in a good way."

² "There were about 60 or 70 Gentlemen concerned in it, and tho' the attempt was extremely hazardous, yet they had resolved on it, and at many secreet meetings encouraged one another to persevere in it."—Baron Clerk's Memoirs, p. 94.

³ Shanons Regiment. The 25th Regiment of Foot (King's Own Scottish Borderers), to which Viscount Shannon was appointed Colonel in 1715. It was raised in 1689 by the Earl of Leven, who was succeeded in 1694 by Colonel Maitland, and he in 1711 by Colonel Breton. Not to be confused with Shannon's Regiment of Marines which Viscount Shannon raised in 1702, and which was disbanded in 1713. See Dalton, Army Lists and Commission Registers, vols. iv and v.

⁴ James Arthur. Dalton gives Ensign James Arthur in this regiment in 1695; he became 1st Lieutenant, 25th August 1702. Is this the officer referred to? One would have expected him to hold higher rank in the regiment by the year 1715.

or thirty we expected with Balhady.¹ The time drawing near my Brother got one Ainsly a Serjant of the greatest interest in the Castle, Cozen Germ[an] to Blackhall² a Laird at Kelso whom I shall have occasion to mention afterwards, appoynted to meet him at a retir'd Alehouse without the walls that had for its' Sign 'Suum Cuique'³ where Barns Dr. Montgomery⁴ and I were waiting for him where taking him to a private Room, never parted with him till he got him perswaded to undertake the matter chearfully. He refus'd money alledgeing himself a gentleman, told my Brother that he needed only two Sentinells and gave him his best advice to whom he shou'd apply—Said he cou'd have the charge of the Guard when he had a mind and assign these men their proper posts, that it would be easy for him to nail all the arms but that they would be usefull to our selfs. The two Souldiers were soon engag'd one of them was son to Holland⁵ who was design'd to be the Messenger of our Success who no doubt was the first who brought your Grace the fatall news. I spoke with the yowng Lad myself and did all I cou'd to animate him. Our affairs being brought to this happy posture we cou'd not refrain to hugg ourselves and my Brother pretending to his wife to goe see my Lord Leven at Melvill went as hard as he cou'd to inform my Lord Drummond of his good fortune. But missing Mr. Forbes at that time was in hazard of beeing apprehended he was oblig'd to follow him five miles higher up the Cuntry which made him a day latter in his return. His wife Concluding that he was gone over to your Grace and that I could not but be acquainted with it, did not spare

¹ William Drummond of Balhaldy (otherwise called MacGregor of Balhaldie). Nephew of Colonel Alan (Allen, Allan) Cameron, brother of Sir Ewen Cameron of Lochiel.

² Blackhall. Who?

³ Suum Cuique Alehouse. Where was this, and what its history?

⁴ Employed by Lockhart to go from Carnwath to Edinburgh to Captain Straton for information. Lockhart Papers, vol. 1, p. 487.

Lockhart's wife was Lady Euphemia Montgomery, third daughter of ninth Earl of Eglinton—was she a relation?

⁵ The two soldiers were, according to the account in Rae's history, "James Thomson and John Holland," who had "received, the one 8 guineas and the other 4, with a Promise of a better Reward, if the Design should succeed." Holland, the father; "Old Holland," as he is afterwards called.

me indeed nor observe any discretion for twenty-four hours.¹ But as she never dream'd of the Castle his return remov'd all her fears and a visit to the Caledon[ian] Coffee house where he treated with Lindsey² about his Commission made all things weel with the Whiggs. Soon after orders came for the troops that lay in Park to march for Sterling the morning of that very day appointed us thursday the 8 of Sept[em]ber, it was our good fortune that we had two days advertisement We met Mr. Wallace³ and three or four others with whom we had kept a decent correspondence from the time of our first communing and letting them know everything that was necessary ; some undertook for ten, other for fifteen who with those we had put up for ourselves by degrees with all imaginable caution amounted to a sufficient number for the attempt considering the interest my Brother had in that Garrison and I by his means, for I must say that never were two persons so happy or counted themselves more so in their Scituation to such an affair, having good reason to reckon the Castle in the King's possession if we cou'd be but once there ourselves with ten or twelve or the lest appearance to support us there beeing none there but Lindsey and Burnbank⁴ whom we could suspect would draw their Swords against us persons as litle regarded by the Garrison as fear'd by us ; Places were assign'd to evry litle Comand ? and those that wanted of their own were directed to a convenient house in their way in the back of Potterow Street where by Mr. Murray of Stenhop's⁵ care were laid for them thirty good pieces

¹ Tom Arthur was then married. His wife, too, knew about her husband's Jacobite proclivities. Was it after all Mrs. Thomas Arthur who peached ?

² Lindsey. Presumably the Lindsey of the Castle afterwards referred to. Does it mean that Tom Arthur wished to re-enter the Army or at least suggested this as a cover to his conspiracy ?

³ Mr. Wallace. Cypher name for whom ?

⁴ Burnbank. Cypher name for whom ? Or is this Porteous of Burnbank ? See Dr. W. B. Laikie's footnote below.

⁵ Murray of Stenhop. Dr. Walter B. Laikie sends me the following note :—

“Sir David Murray of Stanhope and Ardnamurchan, 2nd Bart.

“He was out in the '15, but does not seem to have taken any very prominent part. He was a man of great energy, purchased the estate of Ardnamurchan from Campbell of Lochnell, and developed the lead mines of Strontian. Lockhart of Carnwath (Jacobite manager) thinking that owing to his active habits and constant moving about he would be a

with Screw'd Bayonetts and a great many other small arms and the Chiefs of the different tribes were appoynted to meet my Brother and me at Arthur Reid's Tavern¹ at 8 oc[lo]ck that evening before the attempt which was to be at eleven precisely the round beeing then always punctually at twelve headed by Lindsey for the most part, by my Lord Orm[istoun's]² renew'd Orders to keep them alert. Much about the time we were put to these Shifts Mr. F[orbes] and Balh[aldy] came to Town with about twenty five or twenty six men and the former assuring my brother that all things were right on his Side the man was immediately set to the knitting of his Engine. I paid them a visit with my Brother betwixt five and six that unhappy afternoon with whom I found Barns and Mr. A. according to assignation. Mr. F[orbes] after having entertain'd us with the first Scroll of a very long and positive description of all our proceeding not only for the that evening but for severall days to come which was to be sent the same night to my Lord Drummond by old Holland. He took his leave about six disguis'd in a Hacqueney Coach in order to visit the machine. Upon his return he seemed to be mightily discontented with the work which he s[ai]d he had order'd to be rectify'd. We complain'd very much that he return'd at all in that case.

suitable Jacobite agent, requested him to accept such a post. He declined, stating that after receiving his life (after 1715) from Government he would not occupy himself with plotting, especially as he wished to devote himself to developing his enterprises.

"He, however, added that 'when there's a push to be made I'll venture all with the first' (Lockhart Papers, ii, 249). He died in 1729.

"He married (1) Lady Ann Bruce, daughter of the 2nd Earl of Kincardine; (2) Margaret, widow of Thos. Scott of Whitlaid, and daughter of Sir Wm. Scott of Ancrum.

"By his second wife he was father of John Murray of Broughton, Prince Charles's secretary—the Traitor.

"His grandson, Sir David Murray, 4th Bart., was A.D.C. to Prince Charles in the '45. He was tried, condemned to death, but his life was saved, though his estates were forfeited and sold: the Stanhope property (Stobo, etc.) in Peeblesshire was bought by Jas. Montgomery, Lord Advocate, for £40,500.

"(Sir David Murray, 2nd Bart., was buried in the Canongate Churchyard, 7th February 1729.)"

¹ Arthur Reid's Tavern. What is history of this tavern?

² Adam Cockburn of Ormiston. Senator of the College of Justice, Lord Justice-Clerk, d. 1735. See pedigree table at p. 381 of these Notes for connection by marriage between him and Dr. William Arthur.

But all our interest could not perswade him to goe back nor could we all convince him of the absurdety of sending such a letter, or the impropriety of one so much labour'd from a person to be suppos'd in so great a hurry giving for his reason that it was no matter tho' some incidents vary'd and that his occupations within the rest of the night would not give him time to write. Formerly we had no other exception against him but for the accidents he was lyable unto by his beeing doublely obnoxious to the Messingers but now to our great wonder we found him invincibly possesst with the most unseasonable vanity that ever enter'd the heart of man, to which all considerations else were like to be a Sacrifice. We parted near eight not without abundance of Remonstrances and that he might meet us precisely under the wall at eleven. Barns gave him his watch which was set at the same time with my Brother's. I'm sensible now that I must trouble weary your Grace with a great many trifles most partly relating to myself for no other reason but because I would gladly lay the whole before y[ou]r Grace otherwise without any discontinuation or disjointedness which without that method I know not how to avoid. We all thought it necessary to have poor Wilson the Mathematician¹ but he not beeing fam'd for his talent of keeping Counsel I only orderd him by a billet to meet me at the Exchange Coffee house² at eight ocl[ock] from whence I led him to a private Room in the s[ai]d tavern. He exulted at the proposall and gave us some mirth by saying frankly that he had two books and that if he had other two he wou'd soon shew the town greater wonders than ever Archimedes did at Syracuse with a great deal of that kynd of sublime. I soon got the books and giving him directions to the house mention'd without the port where my brother and I was to call he went off with a lusty fellow from Leith. Dr. Montgomery had sent me with my promise to bring him a pair of fine brass blunderbuss pistolls which Barns had lying for his use at his house in the Potterrow Street. My other offices were to take up six men Aphosk³ promis'd

¹ Wilson the Mathematician. Who was he?

² Exchange Coffee House. Where was this, and what its history?

³ Aphosk. Cypher for whom?

to have waiting for me at a certain Alehouse in the same Street and after having arm'd myself at the house on the left side I was to visit the severall Decads as we call'd them by the way and give them the word and having united my men with the Souldiers my Brother's man s[ai]d he had engad'gd to dessert who were to be at the head of the garden opposete almost to our part of the wall and other three fellows from Leith had comprehended on with my Brother whom he said he would lodge in the Grey fryars Churchyard, I having put them in a convenient Station I had agreed on with my Brother, I was to be before at the foot of the wall in order to goe up first with him hard upon ten reaking it our advantage to have all the gates shut after us. I met with one interruption which gave me abundance of perplexity and fatigue. One Mr. MacKenzie a lusty young Gentleman was sent to my Brother who it seems had fall'n very untimeously into a demurr about the authority we had for what we were about to doe and he not beeing satisfy'd with what my Brother could alledge, I durst not decline the imployment of trying if I could still find Mr. Forb[es] and therefore made him run with all his speed, it beeing then very dark, down to the middle of the Cannongate where he lodg'd. But finding he was gone nine minuts and after having upbraided him and his company rudely enough at the foot of the stair begging him only to hold his peace for one hour I broke off from him at the former rate. He did all he could to to overtake me. But hearing him blow at a terrible rate in a terrible manner I believ'd him resolv'd, and stop't about the trone Church. He begg'd only I would give him leave to bring his sword which he s[ai]d the wou'd doe in a minut I am not able to express the uneasyness I was in he stay'd a long while and ten was struck at which time they shut the Potterrow port. A thousand times I was like to break off but the thoughts of the importance these men might come to be of to us and how censureable I woud be if we suffer'd any thing by the want of them restrained me tho' not beeing acquainted with him I did not know but I might be betray'd. When he came I did not fail to chide him and finding they were all gone from the Tavern I made him begin his race

from the top of Bellswynd to the P[otterrow] Port, which we finding shut and the keye gone we return'd by the Cowgate to the gate of Bristow which was lockt likewise. But finding the old Porter as he was going away with the keye that knew I had several patients without, made the best despatch he cou'd to let us thro' a little wicket and returning by the wall at the old rate I gave my halfe dead Companion leave to draw his breath being sufficiently reveng'd, while I call'd for Aphosk's men. But neither he nor they had been there tho' I was told since that they went to the place. I got Wilson's Pistolls from Barns who came out with me in order to give my Brother ane account of my arriveall and fortune who was hard by Mr. M.,¹ Mr. Porteous of Glenkirk² and severall other friends and with a design to be a distant spectator only for affairs without beeing committed to his Conduct, and having delivered you and beeing heartily glad that I had overtaken my business. I charg'd my piece weel with three ball and hanging her on for the first time with the greatest pride in the world, tho with little skill, and went off with the first man that offerd to goe with me. I found the Gentleman cunningly plac'd amongst the Stacks of pease to whom I gave the parole as I went along and was glad to find that as I had left the town in profound Quiet that all things were so abroad. I traverst all the grownd where the deserters were to be with all the Speed I was able, but in vain and went into the Churchyard on my tiptoes and left not a monument nor a gate untryd, likewise to no purpose. On which I set myself directly to my business. There was a good number of our people on the grassy part of the ascent so weel conceald by the thistles that I was treading on their limbs before I was aware Alexander Stewart³ was there and spoke to me whom I was glad to see in y[ou]r Grace's service in Perth

¹ Mr. M. Perhaps Montgomery?

² Porteous of Glenkirk. From Dr. Walter B. Blaikie I have the following note:—

“Porteous of Burnbank. There was a Porteous of Craiglockhart who had a brother a friend of Sir Hugh Paterson of Bannockburn who was a Jacobite refugee in Paris in 1716 (Stuart Papers, ii, 345, and iii, 7), but there is no evidence that this is the same.”

³ Alexander Stewart. Who was this?

he having been one of them I had engag'd. They told me that it was some minutes after eleven and that the Sentry was begun to call, but that nobody had gone up the rock the Ladder not being as yet come, on which I scrambled up to him as fast as I could in order to encourage him. Whenever he heard me he bid me welcome and letting down a rope with four or five pieces of lead hanging at the end of it desired me to dispatch supposing I had the ladder. I told him over and over as loud as I could venture that it was not yet come but he not seeing me nor hearing what I said the wind then blowing so very high fell a tugging, challenging me constantly say what I could with the most wearisome repetition of these words.—'Is it on, is it fixt?' He told me he was not any of them my Brother had spoke with but that he was employ'd by Ainslie the tothers being reserv'd for another use and that all things were in a noble disposition for us but that we might expect Lindsey at eleven and thus we spent a longer time than twice our number might have gone in over. I desired the Gentlemen below the Rock to send me up some body, on which there came up two; they told me that my Brother and all the Company were as uneasy as the Sentry or myself, on which I beg'd they would desire my Brother either to go or send for it all in haste. In a little one of them return'd telling me my Brother had taken the way as fast as he could. Much about the time that I reckon'd one hour near elaps'd which was all we desired or expected I heard a confus'd noise of voices within, on which I concluded our whole affair ruin'd but being rather resolv'd to perish than give the first suggestion of danger I conceal'd it to the End being firmly resolv'd to push it to the utmost counting it my glory to succumb in so honourable a design. Soon after my Brother dropt down at my Feet in a worse pickle than Mr. McKenzie had been in with this Expression 'My God, I'm quite spent.' After him came one with the Ladder wrapt round his shoulders on the Sight of which I call'd up the Gentlemen who pleas'd me mightily with their alacrity. Whenever it was laid down my Brother knot it to the string with all expedition When the fellow was drawing it up I observ'd the blocks were so small contrary to orders, that the wind twisted the

ladder a thousand ways and neither they nor the hooks beeing cover'd with cloath as they were ordain'd to be, they made a very dissagreeable noise against the wall. But the fellow continuing to pull till he got all in over I believe furnisht us generally with one suggestion. The place from which the fellow let down the string was four or five paces from the Sally Port on the archt turn towards the west kirk and on the brink of a precipice where the wall seemed to be considerably higher and it beeing the Sally port at which we had agreed to goe up with the conveniency of a wall on each side we concluded that he had chosen the first place for his own greater ease in leaning over and taking up the Ladder, and that he was prepareing to let it down where we had hopes it wou'd serve. But while we are in suspence about that, we heard a sudden noise on which the fellow threw our Ladder hastily over which made a dismall rattling for a long time, then fir'd his piece amongst us I don't doubt with sufficient resentment and after him we had a volley from the Patrole. I was grown so stiff with standing there so long after my former violent exercise that when I was got down I found myself alone and after having call'd on my Brother again and again and on the dearest Names to me in the Company to no purpose, not being able to step over the narrow ditch on the side of the way I made a Compass and sat down with my Gun in my hand on the first Sheaves. I had stumbled on a musquet which somebody had left on the Rock by which I had cut my left hand in two places bruise'd my thigh and tore out and shatter'd my pocket with a pistoll I had there. But my Soul was too much fill'd with grief and indignation to advert to anything of that nature. One Mr. Smith¹ returning in search of some friend to take his fate [*sic*] knowing my voice came to me and we going together by the way to the Dean met with Holland² and he beeing my old acquaintance and neighbour, with abundance of kyndness offer'd me his horse that was

¹ Mr. Smith. Mr. Smith was the cypher name of Lord Stormont; W. Smith, junior, that of his son James Murray. Their direct association with the plotters is nowhere stated—is it possible that one or other is referred to here?

² Holland was to have been the messenger conveying intelligence to Mar in the event of success of the plot.

waiting for him and told me where he had a Boat. But not beeing able to bear the thot of bringing y[ou]r Grace the first dismall tidings I chose rather to run any hazard in the Country not without some hopes of doing some service in the Border where I heard they needed to be prompted a little. We got Horses from a niece of mine at Palton¹ where I had made my wife believe I was to be all night and crossing the Pentland hills went to Sir Dav[id] Forb[es']² widow's house, ane Aunt of my Wife's eight miles distant from town where I got one of her Sons to goe in express to get the news and to tell my poor wife that I was well, whom I pity'd mightily having deluded her with so much success that we never had parted with such remarkable chearfulness and indearments and to whom I knew I had never given the lest suspicion by any imaginable token.³ She sent me a most Lamentable Letter telling me that she had been visited by my Lord Orm[istoun] Her Brother Baron Clerk and Sir Jo[hn] Ingles⁴ airly that morning, who finding her Ignorance too plainly by her inundable [*sic*] astonishment desir'd her to invite me home in their name with abundance of fine promises that I cannot think of yet without the utmost scorn⁵ which I desir'd her to let you understand⁶ My w[ife's] interest lying in the neighbourhood⁷ I got what money I demanded and her Factor's horse that he had lately bought out of the Greys. And meeting some Teviotdale Gentlemen at Lady Mary Scots⁸ House three

¹ Palton. I suppose Polton?

² Sir David Forbes of Newhall—married Catherine, aunt of Baron Clerk. (See pedigree table at p. 381.)

³ Again reference to the betrayal.

⁴ Sir John Inglis of Cramond, son-in-law of Lord Ormistoun and brother-in-law of Baron Clerk. (See pedigree table at p. 381.)

⁵ This trio to which Arthur refers with scorn was really a family party closely related to himself. Arthur married Baron Clerk's sister; Baron Clerk married Sir John Inglis' sister; Sir John Inglis married a daughter of Lord Ormistoun, to whom he was also stepson—so that Inglis was Ormistoun's son-in-law and also stepson; Clerk was Inglis' brother-in-law and the husband of Ormistoun's stepdaughter. The pedigree table at p. 381 shows the relationships. And then, as appears later in Arthur's narrative, to them he owed his appointment as Professor.

⁶ Had Mrs. Arthur communication with Mar?

⁷ This refers to Cairnsmuir. Mrs. Arthur's first husband was Sir John Lawson of Cairnsmuir. (See pedigree table at p. 381.)

⁸ Lady Mary Scot's House. Where?

or four days thereafter was recommended by them to Herries and other Friends in the Border who got me conveniently lodg'd in a little village on the English side of Tweed called Leronith¹; while I was at dinner at Cornwall² with a knott of these Merse Gentlemen five or six days thereafter kynd Heav'n sent me that Dear Creature Barns, from whom I never parted till I left whose wisdom fortitude and zeal that he exerted on all occasions Dean³ never thinks of without admiration. He told me that he met a Company of Gentlemen who having lost all patience in waiting for the Ladder were retiring to the Town and that with great difficulty he got them perswaded to return back. We were told by severalls at Perth⁴ that they met Mr. Forbes making towards the Castle a half mile from the Spot as they were making a Shift for themselves. My Brother told me that some Barbers and others of that gang were forming a Contrivance at their bottle of that sort six or seven months before, but I never heard that It took air among the Whiggs or cou'd observe that they lookt after it with any other air than as a place of importance which they might really consider as a good prize tho' I had daily the best opportunitys. I din'd the Sunday before at my Lord Ormeystown, smoakt a pipe the same week with Major Aikman,⁵ in his Club at the King of France's "dredgy"⁶ as they call'd it which then they observ'd evry night, and I may add that Baron Clerk din'd with me the very day before, who at that time was inseparable from

¹ Leronith. Where?

² Cornwall. Where? Dr. Walter B. Blaikie has given me the following information:—

"*Cornwall*, I imagine, is really *Cornhill*, pronounced Councill or Cornell, a village (near Coldstream) on the English side of the Tweed, but I do not know *Leronith*. Perhaps a careful scrutiny of the Ordnance Survey Map might show a survival of the name somewhere in the neighbourhood of Coldstream. I have, however, little doubt that the word is a mistranscription of *Learmouth*, a place a little to the south of Cornhill."

³ Dean is, I take it, Arthur's cypher designation.

⁴ Arthur must have gone with Barns to Perth. Arthur refers to seeing Alexander Stewart "in yr. Grace's service in Perth." (See p. 394.)

⁵ Major Aikman. Probably James Aikman of Preston's Regiment. Perhaps related to Aikman the portrait painter (see pedigree table at p. 381).

⁶ King of France's "dredgy." Is there a history of this?

my Lord Ormestoun and who readily would have dropt something or other of it, My wife and I being his greatest favourites. But of my terms with these people I need give no other demonstration than that they had made but now lately procur'd me a Commission whereby they made me Professor of Botany and materia medica for N[orth] B[ritain], Sub-Keeper of the R[oyal] G[ardens] at Edinburgh and anything relating to that subject that I was pleas'd to put in the Commission myself exempting me likewise from the abjuration. Thus I have giv'n y[ou]r Grace a most dispassionat account of the whole affair so far as it came to my knowledge If there was anything more in it time and some other evidences will bring it to light. I shall leave it to y[ou]r Grace's Judgment without presuming to make any animadversions. Barns no doubt would give y[ou]r Grace ane accurate account of all that passt from our meeting till we saw y[ou]r Grace¹ and I'm hopefull that y[ou]r Grace will very shortly receive from his hand a more perfect deduction of what I am to undertake by y[ou]r Grace's command. He having besids an infinitely superior Judgm[ent] a much greater happyness in remembering time with the names of Persons and places" [9½ pages].

[*Endorsed.* A paper left by Doct. Arthur when a dying at Rome with Doct. Kenyon to be given to Lord Mar. R[ecieved] at Avig[non] Nov. 3rd, 1716."]

The two following extracts from the Marchmont MSS. published in the Fourteenth Report, Appendix, Part III of the Historical Manuscripts Commission, are immediate postscripts to the story written by Arthur:—

(Page 163.)

"LETTER from Adam Cockburn, Lord Justice-Clerk, to (Lord Polwarth). Edinburgh, 11th September 1715.—Intimating the meetings of the noblemen in the north and the setting up of King James's Standard at Braemar by the Earl of Mar, who 'persists with great keenness in his designe. Whether the defeating the design, Thursday's night, they had on the Castle of Edinburgh will put a stop to their march southwards I doe not know. The

¹ Arthur and Barns met Mar then after the failure. Was this at Perth when they heard of the conduct of Forbes?

designe on the castle was very well laid, it was discovered about nine at night, and as they had concerted they begune to putt it in execution between 11 and 12. They were actually getting their ladder drawn up, by a sentinell they had corrupted within the garrison. We have gote the ladder and other materials with a number of arms they left when they rune. The Highland men, above 20 of them were at Kinross nixt day ere they halted. We are bussied to find out the plotters; there are several taken up; some were seised, one comeing from the wall with a fire lock in his hand without hat or wige, they call Captain McClean, another, Leslie, taken at the root of the wall, mistook the town guards for some of their own folks and gave the parolle which was St. Andrew. Had the castle been taken they were to a given the signal by three rounds of the guns, all their friends were to hasten hither and the body of the Highland army was to march presently for the south," etc.

(Page 164.)

"LETTER from 'George Drummond' (afterwards Provost of Edinburgh) to Lord Polwarth. 'Munday, one a'clock, 12th September, 1715.'—Giving some reports of the rebel movements. He also states that in expectation of a second attack on the castle of Edinburgh 'a lieutenant and 24 men of the town guard with 30 of us went out and kept guard at the back of it all night in Livingstouns yards, but we had the pleasure of coming into town safe in the morning without having seen an enemy. . . . On Saturday, one of Arthur's accomplices called Johnstoun, an old servant of Leven's was apprehended in the town: he confesses he was with him Thursday att 9 att night, went in quest of him att the back of the wall att 11, says he mist him, owns he lay att a stouk side all night, but will go no further. He is in close prison feeding on bread and water. The other centinell confessed all on Saturday, but the corporal continues yet a disingenuous dog.'"

Of Dr. Arthur's movements subsequent to the flight he himself describes we know little. That he was in direct communication with and met the Earl of Mar we gather from his own statement, and also from the record by Patten of his arrival on the Borders:—

"There were no Hostilities used here, only the Horse going out a Foraging, went to a Seat of the Duke of Roxburgh's near the Town, and brought in some Hay. While they continued here, Dr. Arthur, a Gentleman concerned in that designed Attempt upon the Castle of Edinburgh, of very good Parts, and generous Education, and one Mr. Cunningham of Barnes, came from the Earl of Mar with Intelligence, and returned to him again; after which, the same Gentleman came again to the Rebels when at Preston."

We hear of him next in Italy, and from Rome he wrote the autobiographical account of the Castle plot reproduced above, and which was transmitted to Mar by Dr. Roger Kenyon, as the following letter—also transcribed from the Calendar of the Stuart Papers—explains:—

"Dr. Roger Kenyon to the Duke of Mar.

"1716, October 17. Rome.—Enclosed is the legacy of an honest man, and a very faithful subject, Mr. Arthur, who, after escaping a thousand dangers in the King's cause, met his death where he came for safety by eating a few figs, which threw him into a dysentery. The day before he died, he ordered these papers to be delivered me, and desired me to send them you with some excuse for their coming in a form so little fit for your perusal. Had God allowed him a longer time, that would have been amended, and you would have received with these an account of what passed at Preston in his observation. You will receive them just as they were delivered me, and I have only to add, that, several being named who may yet be in danger or unwilling to be generally known, he assured himself you would take care, that living or dying, he might be hurtful to nobody. I had known him only since my coming here, but, as far as I could judge, besides a true zeal in the King's cause, an excellent heart, and no talents wanting to have made him most useful in his station, he seemed to be a great lover of truth, not only so as not to alter it, but even to speak it, where it might not be over grateful. This may make his relation even in the lesser circumstances of it, of more regard, and, since it came to my hands, it has been seen by nobody. We had permission to bury him by the sepulchre of Cestius, a piece of an-

tiquity well known here and within the walls, which is esteemed a favour to us sort of people, and was procured by means of Cardinal Gualterio."

To this letter is appended a paper endorsed "Pour ensevelir à Rome un Protestant," of which the following is a transcript:—

"Nota della spese per il funerale del Mr. Arthour.

Per la croce	10	
Per il curato	20	
Per 12 sacer doti con cotta	1	20
Per l'offitio con il curato e 4 sacerdoti	60	
Per la messa cantata	150	
Per la sepultura	150	
Per le campane	30	
Al beccamorto	65	
Per li banchetti solto il cata letto	40	
Per il sacco	20	
Per 2 fucchini	20	
Per 4 portatori	40	
Per la guardia	1	0
Per cera:—		
8 torcie di lb 3	lb	24
10 ceri in chiesa di lb 3	lb	30
6 candele per l'altar maggiore	lb	6
14 candele per l'altari bassi	lb	3·6
1 candela per il curato	lb	1
15 candele d'oz 2 per li sacerdoti	lb	2·6
per il libera me, Domine	lb	2
per la guardia	lb	1
		18·20
	lb 70	26·45"

For the presentation of the story which I now end, I have had to travel somewhat beyond my normal calling. I only wish that I could have devoted time to the editing Dr. Arthur's confession by the addition of explanatory notes referring to persons and places he mentions, and to further search for information to make the story more complete. I have held back the MS. for long in the hope of being able to do this, but as the prospect does not

brighten I put in print now what I have. All I claim in it is that I have removed doubts and uncertainties that have hung over a period in the history of my predecessors in the Keepership of the Royal Botanic Garden. Nowhere in any of the documents referring to Arthur is mention made of his having performed the duties of his Professorship. Possibly during the summer months after his appointment in May 1715, he may have given some attention to the Royal Garden and held colleges there before his obsession by the political scheming which ended in the abortive Castle Plot. We have no evidence. And we must bear in mind that from 1706 the direction of the Town's Botanic Garden and the Professorship of Botany in the University were in the capable hands of Dr. Charles Preston first of all, and then of his brother George Preston. Their teaching would be in rivalry of that in the Royal Garden, and doubtless they had acquired by the time that James Sutherland left the Royal Garden a practical monopoly of the teaching, inasmuch as Sutherland had given himself up entirely to numismatics. In any case Arthur's botanical work must have been of the slightest.

One cannot but feel on reading Arthur's story of his exploit that he was hardly of the stuff of which successful conspirators are made. That it was through him that information of the plot was conveyed to those who could stop it, is not, as I have pointed out, beyond question. He certainly suffered severely through the failure. The Earl of Mar's opinion and appreciation of his services are cynically shown in the following letter:—

"The Duke of Mar to Captain Harry Straton.

"1716, November 15.

"A countryman of yours, a very pretty young man, is lately dead at Rome, Dr. Arthur, and his brother Tom, who is at Francis' quarters (the Firth of Forth), has fallen so ill on it, that 'tis feared he'll die too. The Doctor at his death, I hear, declared he was a Presbyterian, but a loyal one, as he called it, which he thought was not at all inconsistent. You know what was his kind of loyalty. Pray are many of your Presbyterians of his opinion?"

Cal. Stuart Papers, iii, p. 215.

I wish to record my obligation to Mr. F. H. Blackburne Daniel, Editor of the Calendar of the Stuart Papers, to the Hon. J. W. Fortescue, King's Librarian at Windsor, to the Lyon King, and to the Rev. Henry Paton for help freely given in the compilation of this story of Professor Arthur.

I have also to thank Dr. Walter B. Blaikie for information which appears in the notes.

NOTES ON SOME SCOTTISH PLANTS. By JAMES FRASER.

(Read 7th October 1914.)

The following list of plants, observed during 1914 except where otherwise indicated, consists of "aliens" new to Britain (these are marked by a star), new records for vice-counties, and plants considered sufficiently interesting to have new localities for them put on record.

* *Arabis auriculata*, Lam.—Several near Musselburgh, v.c. 83.

Impatiens glandulifera, Royle.—Several by the side of a burn near Loanhead, v.c. 83.

Vicia tetrasperma, Moench.—Abundant on railway bank at Dirleton. A new record for v.c. 82.

Coronilla varia, Linn.—A colony 20 feet in diameter, near Loanhead, v.c. 83.

Epilobium angustifolium, Linn.—Several clumps near Loanhead and near Colinton, v.c. 83. Patches on railway banks near Aberfoyle (in 1913), v.c. 87. Patches on railway bank near New Luce, v.c. 74.

* *Vaillantia muralis*, Linn.—Several near Musselburgh, v.c. 83.

Carduus nutans, Linn.—Plentiful at Straiton, v.c. 83.

Petasites fragrans, Presl.—A large colony near the Esk at Inveresk; a colony on the left bank of the Water of Leith at Colinton, v.c. 83.

Symphytum officinale, Linn.—One clump with yellowish petals touched with purple, by the side of the Lyne two miles below West Linton, v.c. 78. Not hitherto recorded for Peeblesshire.

S. peregrinum, Ledeb.—One clump near Longniddry, v.c. 82. A large colony near Lamancha (in 1912 and 1914); by the side of the Lyne above and in West Linton; several near Dolphinton, v.c. 78. One clump at Straiton and several near Loanhead, v.c. 83. Abundant in Dysart Woods; several near Cupar, Kirkcaldy, Charlestown, and Torryburn (Mr. Templeman sp.), v.c. 85. Several at Symington and at Abington (Miss Dickie), v.c. 77.

S. orientale, Linn.—Several in private grounds at Aberdour (Mr. Saunders sp.); abundant in Dysart Woods and several in Raith Grounds, v.c. 85. Abundant in Spylaw Park, Colinton, v.c. 83.

Salvia verticillata, Linn.—Several patches at Straiton; a clump on railway bank near Gorebridge; one in old quarry at Slateford; one on railway bank at Inveresk, v.c. 83. Several at Burntisland and on the railway bank near St. Monans, v.c. 85.

Allium paradoxum, Don.—Several large patches near the Esk at Inveresk, v.c. 83. (Mr. Templeman com.).

Koeleria vallesiana, Asch. et Grbn.—Abundant among esparto grass casuals near Musselburgh, v.c. 83.

Poa Chaixii, Vill.—In immense quantities in the private grounds of The Inch, Liberton, v.c. 83. A large patch in Pittencrieff grounds, v.c. 85.

* *Festuca Salzmanni*, Boiss.—Several near Musselburgh, v.c. 83.

NOTE ON THE OCCURRENCE IN SCOTLAND OF MEGASTIGMUS PINUS IN THE SEED OF ABIES NOBILIS, LINDL. By JAMES FRASER, B.Sc.

(Read 7th October 1914.)

The Chalcid family of the order Hymenoptera contains a very large number of species, the great majority of which are parasitic on other insects. Some species, however, are phytophagous in habit, and of these, several, belonging to the subfamily *Megastigminae* and the genus *Megastigmus*, lay their eggs in seeds: in these seeds the larvae hatch and feed so that the seeds are ruined. Pupation of the full-fed larvae takes place under

cover of the hollowed-out seed, from which, when ready, the adult insect issues by a hole.

Of *Megastigmus* species that infest conifer seeds three have been recorded in Britain:—

Megastigmus pinus, Parfitt, of this note;

Megastigmus spermatrophus, Wachtl.; and

Megastigmus strobilobius, Ratz.

Megastigmus spermatrophus was first described as a new species by Wachtl. of Vienna, in 1893, the insects having issued from the seeds of the Douglas Fir. In 1906 this insect was recorded by MacDougall¹ in the seeds of Douglas fir from Aberdeenshire where the insect had proved very destructive. Later, in 1909, the species was recorded by Crosby in a bulletin from Cornell University. The seed from which he obtained his specimens came from Colorado, the home of one variety of the Douglas fir.

M. strobilobius was first recorded by Ratzeburg in 1848 from seeds of *Abies pectinata*. It has been recorded in the United States by Crosby. In Britain it has been found by Mr. A. C. Forbes and has been described by Gillanders.

Megastigmus pinus, Parfitt. — This species was first described by Parfitt in 1857. Various coniferous species had been named as hosts of the species, but there are authentic records of its living in the seeds of *Abies nobilis*. In the National Collection at the British Museum, in addition to the 1857 record, there are two records: one of two males and two females from Mr. A. Murray, and a British record in 1904 of specimens received from Wm. Vicary, Esq. The present record is of a female specimen from the seeds of *Abies nobilis*. It was found dead on 9th July among some seeds which were to be used as a museum exhibit. The occurrence of the insect suggested an examination of the seed for traces of damage. Out of 110 seeds, four were found which had certainly been attacked by an insect grub. A dissection of one of these seeds showed it to be completely destroyed; a small amount of frass was left within the empty shell. The seeds among which those damaged individuals were found were sent over by a firm of German nurserymen in Hamburg. Present circumstances render an inquiry about the locality

¹ *Transactions of the Royal Scottish Arboricultural Society*, 1906, vol. xix.

of the seed impossible. The fact that home-collected seeds in this country germinate freely renders it possible that they were from German-grown trees.

Abies nobilis seeds do not retain their power of germination for more than one winter, and they are sensitive to drought. These facts would probably point to October 1913 as the date on which the seeds were collected.

The record and the specimen are of interest as there are at present no details of its biology: it is possible that it may direct attention to the cause of the damage; and material and information which will help to complete the life-history would be welcomed.

Abies nobilis as a park tree is well known, and varieties of it are highly valued on account of their very beautiful appearance. In such trees the occurrence of the insect named would be of comparatively small importance. The tree in its own country is valued on account of the timber, which is sometimes sold as larch: it is, for indoor work, equally valuable, but does not possess the durability or strength. In this country it is fairly common in small plantations. It is possible that the yield of seed from these might be seriously affected by the insect. A comparison of the area of distribution of the Douglas fir and of *Abies nobilis* shows that a very considerable part of the areas is common to both. It would be natural to conclude that the natural home of the Douglas fir is also the home of its seed parasite, and both have adapted themselves well to conditions in this country. The seed parasite of the Douglas fir is now a well-known enemy: a similar adaptation of host and parasite may result in the case of *Abies nobilis* unless a suitable remedy can be procured and applied.

I desire to thank the Rev. James Waterston (Imperial Bureau of Entomology) for kindly informing me of the previous records, and Dr. Stewart MacDougall for directing me in my search for the identity of the specimen.

JUNCUS TENUIS, WILLD.; ITS DISTRIBUTION IN THE
BRITISH ISLES. By ARTHUR BENNETT, A.L.S.

(Read 14th January 1915.)

J. tenuis, Willd., Sp., pl. ii, 214 (1799).

J. gracilis, Smith, Comp. Fl. Brit., 55 (1800).

J. macer, Gray, Nat. Ann. Brit. Plants, ii, 164 (1821).

J. Gesneri, Smith, Eng. Fl., ii, 164 (1824).

J. Smithii, Kunth, Enum., pl. iii, 349 (1841).

J. bicornis, Michx. ! Pluk., t. 92, f. 9 (bonne) ex Lloyd.
Fl. Ouest Fr., ed. iv, 366 (1886); Eng. Bot., t. 2174 (1810)
“*J. gracilis*.”

Its European distribution (Nyman) is France, Belgium, Holland, Germany, Bohemia, Jutland, Russia in South and West.

Kunze, Tasch., Fl. Leipz., 55 (1867) names it *J. compressus* × *effusus*, a combination that can scarcely apply to our plant, as it produces seed in abundance.

Leaving out of consideration Don's and Dickson's records of the species, it was found by Mr. Towndrow in the parish of Cradley, Herefordshire, in 1884. During the last thirty years it has been recorded for twenty-two counties in Scotland and England, and four in Ireland.

As the species has retained its station in Renfrew from 1863 to 1889, and still grows there, it may be supposed to be at least on the road to becoming naturalised. Although some consider it may be native, as Mr. Kidston in Stirling who wrote in 1889: “On roadside, not in the grass edges, but the sandy margins of road. I do not say there was not a single specimen in the grass edges, but it distinctly seems to grow only in open ground with a light sandy soil as is found at the sides of our roads, where the soil is probably made additionally light by the wear and tear of the trap rocks with which the roads are ‘metalled.’ I shall try to look into the whole matter: I do not believe the plant is introduced.”

On the other hand, there are places where it has occurred in which it is certainly introduced, and in 1897 (14) I ventured to suggest it was introduced with American hay,

The history begins with Smith in the Green Fl. Scot. in 1810, in Eng. Bot., t. 2174, he records it as found by Mr. G. Don in 1795 or 1796, by the side of a rivulet in marshy ground among the mountains of Angus-shire, but very rarely. It appears to us to be a nondescript, but we received from Mr. Dickson, some few years before the above date, a specimen, not so far advanced towards maturity, of what seems to us the same species." Hence it was recorded in the Floras with more or less distrust: then Mr. Towndrow's (3) record, followed the following year by a plate and description, etc., by Mr. Ridley (4).

In 1887 Mr. J. McAndrew (2), then of New Galloway, sent me specimens from the "roadside where it grew for about three-quarters of a mile west of New Galloway, near a house, with *Juncus squarrosus*, *J. lamprocarpus*, grasses, etc., and one cannot see how it could have come there." These specimens are much more native looking than any others I possess, and are stout, well grown, and with abundance of seed.

In 1889 Dr. Scully (6) reported it from Ireland in Co. Kerry, and since that date (as will be shown later) records have been frequent. A list of the Irish localities is given in the 2nd edition of the Cybele Hibernica, p. 359 (1898). There, and by Dr. Scully (6), the kind of stations, etc, it is found in are fully described. At p. 389 the authors remark: "The wild rocky peninsula between Kenmare River and Bantry Bay, where, in parts, it seems to be the commonest of the Junci, and has at least all the appearance of a native."

In August 1863 Mr J. Thomson of Dennistoun, Kilmalcolm, sent a specimen to the Greenock Museum, under the name of *Juncus acutiflorus*. In October 1866 (18) Messrs. King, Ewing, and Thomson, found the plant "in great or less abundance, at a place where the soil is rather sandy." It occurred between Bridge of Weir and Kilmalcolm, the original (1863) locality.

With regard to the original specimens of Don, Messrs. King and Aughton, in the 6th edition of the Brit. Flora, remark: "We have specimens from Don's

garden, but we doubt much if the roots were ever found in Clova."

Mr. Druce (17) remarks: "In Don's collection of grasses, etc., is a specimen of this labelled 'Clova.' I consider it *tenuis*, and Miss Palmer has a specimen contained in a collection of plants sent in a living state to the 4th Countess of Aylesford, and afterwards preserved by her, and lent to Mr. Druce by her granddaughter Miss C. Palmer.

In N. America, in the United States, it is very common in low grounds and fields. In Canada, from Halifax to Vancouver, usually in boggy pastures, or along old roads in woods.

I now give its present distribution, using Mr. Watson's counties and Mr. Praeger's Irish divisions, and giving dates and authorities.

2. Cornwall, E., 1894	. . .	Jour. Bot., 311.
4. Devon, N., 1895	. . .	Jour. Bot., 282.
6. Somerset, N., 1914	. . .	W. White sp.
9. Dorset, 1914	. . .	W. White, Jour. Bot., 340.
14. Sussex, E., 1907	. . .	Salmon and Hilton sp.
15. Sussex, W., 1907	. . .	Salmon and Hilton sp.
17. Surrey, 1914	. . .	Miss Cardew sp. ex Salmon.
36. Hereford, 1884	. . .	Towndrow sp.
48. Merioneth, 1912	. . .	Jones sp. ex Pickard.
49. Carnarvon, 1896	. . .	L. Williams, Jour. Bot., 201.
59. Lancashire, S.,	. . .	Mason sp.
73. Kirkcudbright, 1887	. . .	M'Andrew sp.
74. Wigton (?)	. . .	Trail MS.
75. Ayr, 1911	. . .	Ex. Club Report, 598 (1912).
76. Renfrew, 1863-1889	. . .	Ewing sp.
78. Peebles, 1912	. . .	M'Andrew.
83. Edinburgh, 1912	. . .	M'Andrew.
86. Stirling, 1894	. . .	Stirling and Kidston sp.
87. Perth, W., 1903	. . .	Miss Armitage sp.
88. Perth, N., 1908	. . .	Ewing sp.
89. Perth, E., 1912	. . .	Barclay sp.
90. Forfar, 1906	. . .	Ann. Soc. Nat. Hist., 231.
91. Kincardine, 1903	. . .	Ann. Soc. Nat. Hist., 251.
92. Aberdeen, S., 1896	. . .	Ann. Soc. Nat. Hist., 7.
97. Westernness, 1896	. . .	Miller sp.
98. Argyll, 1910	. . .	Marshall sp.
99. Dumbarton, 1891	. . .	Watt sp.

IRELAND.

Kerry, 1899	. . .	Scully sp.
Cork, 1894	. . .	Phillips } Praeger, Irish Top. Bot.,
Clare, 1895	. . .	O'Kelly } 310, 1901.
Down, 1903	. . .	Stewart, Irish Nat., 108.

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- (2) A. BENNETT.—*Scot. Nat.*, 181, 1887.
- (3) TOWNDROW.—*Jour. Bot.*, 91, 1884.
- (4) RIDLEY.—*Jour. Bot.*, t. 253, 1885.
- (5) M'ANDREW.—*Jour. Bot.*, 374, 1887.
- (6) SCULLY.—*Jour. Bot.*, 335, 1889.
- (7) EWING.—*Jour. Bot.*, 120, 1891.
- (8) A. BENNETT.—*Jour. Bot.*, 39, 1895.
- (9) C. E. SALMON.—*Jour. Bot.*, 259, 1910.
- (10) J. W. WHITE.—*Jour. Bot.*, 340, 1914.
- (11) *Ex. Club Report*, 1889, 271, 1890.
- (12) MACVICAR.—*Trans. Bot. Soc. Edin.*, 184, 1889.
- (13) EWING.—*Trans. Nat. Hist. Soc. Glasgow*, 166, 1892.
- (14) { A. BENNETT.—*Ann Scot. Nat. Hist.*, 32, 1897.
MACVICAR.—*Ann. Scot. N. Hist.*, 197, 260, 1897.
- (15) TRAIL.—*Ann Scot. Nat. Hist.*, 251, 1903.
- (16) BARCLAY.—*Ann Scot. Nat. Hist.*, 59, 1904.
- (17) BALFOUR AND DRUCE.—*Notes Edin. Bot. Garden*, 1904.
- (18) BARCLAY.—*Scot. Bot. Review*, 235, 1912.

In any future records will the finders give careful accounts of the surroundings, and species, etc., with which it occurs, so that some consensus of opinion as to its grades and status in our isles may be formed.

THE PHARMACOPOEIA OF A BOTANICAL PHYSICIAN LATER.

By The Hon WILLIAM RENWICK RIDDELL, B.Sc., B.A.

(Read 11th January 1915.)

In a paper entitled "The Pharmacopoeia of a Botanical Physician Eighty Years Ago," read before this Society 13th November 1913,¹ I enumerated the remedies recommended by Samuel Thomson, founder of the Thomsonian System of Medicine, as found in a publication of 1832. He failed of recognition by the Regular Profession, but had many disciples. They took the title, T.P. (Thomsonian Practitioner), and had no little vogue throughout New England, New York, and many other parts of the Union. As was to be expected, they did not confine themselves to the remedies recommended by their master, but discovered others, chiefly botanical, either in substitution of or in addition to the original.

¹ See page 226 of this volume

In 1843 was published a 12mo volume at Bennington, Vermont, entitled:

THE
BOOK OF HEALTH
OR
THOMSONIAN THEORY AND PRACTICE OF MEDICINE
INCLUDING THE LATEST VIEWS OF PHYSIOLOGY,
PATHOLOGY AND THERAPEUTICS

BY
F. K. ROBERTSON, T P
Licentiate of the N Y & Thomsonian Medical Society
and Lecturer on Medical Science

ALSO
DESCRIPTIONS OF DISEASE, MEDICAL PRACTICE
AND MATERIA MEDICA

BY SILAS WILCOX, T P
Licentiate of the Vt S Thomsonian Medical Society

Designed for Every Body

BENNINGTON
PRINTED BY
J I C & A S C COOK
1843

I do not say anything about the views expressed in that work on Physiology, etc., but pay attention only to the *Materia Medica*

It will be seen from the list given below how far the Thomsonians had got beyond Thomson, indeed, the authors do not hesitate to say that he may be wrong

Not much attention is paid by these authors to the Courses of Physic upon which Thomson laid so much stress, although formulæ are given for his Six Numbers. No. 1, Lobelia in one form or another, No 2, Capsicum or Black Pepper, etc, in tincture, No 3, Bayberry, Sumac, etc., as an astringent, No. 4, Golden Seal, etc., for Bitters, No. 5, Poplar, Bayberry, etc., as a stomachic, No. 6, Myrrh and Capsicum in tincture (still met with as Tr. Caps. Co.). Formulæ are given also for "the Thomsonian Panacea,"

Tonic Composition, Diaphoretic Composition, Anti-Dyspeptic Conserve or Bread of Life, Dyspeptic Powders, etc., etc.

But the more usual course is to prescribe one or more plants for each particular disease.

Below will be found particularised the medicines employed. Where the qualities of the plant as given are the same as those given in the earlier work, I do not set them out here.

It will be seen that the Vermont practitioners do not employ Nos. 8, 13, 16, 17, 25, 27, 28, 29, 33, 34, 36, 40, 41, 48, 54 of Thomson's list and add 67 of their own, making a total of 113 native plants in their pharmacopoeia. They also considerably enlarge the list of exotic plants, as well as of animal and mineral products. They excuse the use of sulphuric acid and Glauber's salts in case of lead poisoning thus: "Let it not be supposed that these articles are opposed to a *natural practice*; for they contain nothing that is not found in the ultimate elements of the human body, and are not radically poisonous: besides, to arrest a deadly chemical agent in the body, it is not absurd to use some more mild chemical substances as a counter agent."

The following list gives all medicines mentioned in the entire work:—

(N.B.—In this list all numbers from 1 to 58 inclusive are to be found mentioned in the work by Samuel Thomson, published at Hamilton, Upper Canada, in 1832. All those above 58, and also such of those in the former list as are not enclosed in parentheses, are to be found mentioned in The Book of Health, by Robertson and Wilcox, published at Bennington, Vermont, in 1843. The names in italics are those used by the authors.)

RANUNCULACEAE.—1. *Golden Seal*, *Hydrastis Canadensis*, "a good bitter tonic, slightly laxative, the root."

59. *Goldthread*, *Coptis trifolia*, a tonic and astringent (the root only is used), administered in Scarlet Fever, etc.

60. *Black Cohosh*, *Cimicifuga racemosa* (called *Macrotys racemosa* in this work), "the root is aromatic and stimulating; loosens the lung and vomits; the leaves are bitter and cause sneezing."

MAGNOLIACEAE.—61. *White-wood*, *Liriodendron tulipifera*:
“An active tonic, good for Hysteria. The bark.”

NYMPHAEACEAE. — 2. *White Pond Lily*, *Nymphaea odorata* or *N. tuberosa*, the root used as an astringent.

PAPAVERACEAE — 62 *Celandine*, *Chelidonium majus*.
Used in a tincture for Ringworm and Tetters, also to promote the secretions of the Liver.

63 *Bloodroot*, *Sanguinaria Canadensis*, an ingredient in Pulmonary Balsam, an emetic, made into a salve with beef's gall for Cancer, as a powder sprinkled on ulcers and specific sores, and snuffed up for Polypus and Catarrh. It also removes proud flesh and is good for Cough and Croup.

CRUCIFERAE — 3 *Mustard*, *Brassica nigra*.

4 *Horseradish*, *Nasturtium Arminiacum*

64 *Raddish*, *Raphanus sativus*, juice used for renal calculi

65. *Cabbage*, *Brassica oleracea*, preventative of and a remedy for scurvy.

66 *Scurvy Grass*, *Barbarea praecox* preventative of and a remedy for scurvy

TILIACEAE — 67 *Basswood*, *Tilia Americana* Wilted leaves applied in Erysipelas

LINACEAE — 68 *Flaxseed* (*linseed*), *Linum usitatissimum*.
For poultices and mucilaginous tea

GERANIACEAE — 69 *Wood Sorrel*, *Oxalis acetosella*, the inspissated juice used as a vegetable caustic for cancers and tumors.

70 *Cranesbill*, *Geranium maculatum* an ingredient in Dysentery Powder, given as an emetic in mineral poisoning and as an enema in Flooding

RUTACEAE — 5 *Prickly Ash*, *Zanthoxylum Americanum* (called here *Xanthoxylon fraxineum*), a fine diffusible stimulant, without producing much heat — sweating, quieting and purifying—the bark and berries

71 *Rue*, *Ruta graveolens*, an ingredient in nerve ointment

72 *Lemon*, *Citrus Limonium*, used in lemonade as a cooling and acid drink

ANACARDIACEAE — 6 *Sumac*, *Rhus typhina* or *R. aromatica*—in this work the species *R. glabra* (here called *glabrum*) is specified. It is very widely used and in almost all kinds of diseases.

CELASTRACEAE. — 73. *Bittersweet*, *Celastrus scandens*, "the bark of the root makes a very valuable ointment for swellings," and is also an ingredient in the Nerve Ointment.

SAPINDACEAE — 74 *Striped Maple*, *Acer Pennsylvanicum*, wilted leaves applied in Erysipelas.

LEGUMINOSAE — 7 *Red Clover*, *Trifolium pratense*.

75. *Cassia* (or *Quassia*), *Cassia Marylandica*, an ingredient in wine bitters and given for suppression and chlorosis.

76 *Wild Indigo*, *Baptisia tinctoria*, "makes an excellent poultice to prevent mortification and for ulcers—the bark of the root."

ROSACEAE.—Rose family proper. (8. *Evan Root*, *Geum rivale*.)

9 *Red Raspberry*, *Rubus triflorus* or *R. strigosus*.

77. *Blackberry*, *R. villosus*, the root of which is used in making dysentery powder.

78 *White Strawberry*, *Fragaria Virginiana* (var. *alba*) as a diuretic, the vine is one ingredient in a drink given in Renal calculus

79 *Roseleaves*, *Rosa* (different species), ingredient in eye water

The Pear Subdivision 10 *Peach*, *Prunus Persica*

11 *Wild Cherry*, *Prunus Pennsylvanica*.

80 *Black Cherry*, *Prunus serotina*, bark used in spice bitters, dysentery powder and fruit in Improved Rheumatic drops

81 *Apple*, *Pyrus Malus* sour apples roasted are given as a drink in Typhus Fever

HAMAMELACEAE — 12. *Witch Hazel*, *Hamamelis Virginica*.

HALORAGIDACEAE — 82 *Marestail*, *Hippuris vulgaris*, a snuff made of this will cure nose bleeding immediately

UMBELLIFERAE (13 *Archangel*, *Archangelica atropurpurea*)

83. *Carrots*, *Daucus Carota* applied as a poultice in abscesses.

84 *Parsley*, *Carum Petroselinum* (*Petroselinum sativum*), the root an ingredient in Pulmonary Balsam and used as a diuretic

ARALIACEAE — 14 *Genseng*, *Aralia quinquefolia*, called in this work *Panax quinquefolia*, "nervine and tonic, good in dyspepsia, debility and irritability of the nerves"

85. *Spikenard*, *Aralia racemosa*, used in making Pulmonary Balsam, "healing, purifying, good for the lungs. Root and berries."

86. *American Sarsaparilla*, *Aralia nudicaulis*, used in making Alterative Syrup (*Sarsaparilla Syrup*), given for Tetters and specific disorders.

CORNACEAE.—87. *Borwood* or *Rose Willow*, *Cornus florida*, flowers or bark used in making Female Restorative, "tonic and strengthening, a substitute for Peruvian bark, valuable in female sickness."

88. *Green-osier*, *Cornus sericea* (Kinnikinnik), made into a tea for bathing inflamed eyes, a poultice for cancer and an ingredient in the Alterative Syrup "Heating and purifying, good for sore eyes, stops vomiting The bark."

CAPRIOLIACEAE.—89 *Elder*, *Sambucus Canadensis*, or *S. pubens*, bark used in making Diuretic Cordial, flowers in Alterative Syrup

90. *High Cranberry*, *Viburnum Opulus* (called *V. Oxeconus* in this work), bark used in making "Mothers' Relief," an ecboic, "relaxes spasms"

RUBIACEAE.—15 *Uivers* or *Cleavers*, *Galium Aparine* "an active diuretic, very good in Strangury, gravel and dropsy."

91. *Partridge Berry*, *Mitchella repens*, the bark for renal calculi and as an ecboic.

VALERIANACEAE.—(16 *American Valerian*, *Valeriana sylvatica*.)

COMPOSITAE.—(17. *Squaw-weed*, *Senecio aureus*.)

18. *Elecampane*, *Inula Helenium*, "tonic and expectorant, very good in consumption, the root"

19. *Mayweed*, *Maruta Cotula* (called in this work *Anthemis Cotula*), generally called Smartweed.

20. *Wormwood*, *Artemisia Absinthium*.

21. *Tanzy*, *Tanacetum vulgare*.

22. *Chamomile*, *Anthemis nobilis*.

23. *Burdock*, *Lappa officinalis*.

24. *Thoroughwort* is in this work called *Boneset*, *Eupatorium perfoliatum*, an emetic or used as a tea to induce perspiration, "a valuable universal medicine, a hot infusion sweats and vomits, cold it is a laxative."

(25. *Featherfew*, *Chrysanthemum Parthenium*.)

26 *Golden Rod*, *Solidago nemoralis*, called in this work *S. odora* (i.e. *odorata*), made into a tea for headaches.

(27. *Wild Lettuce*, *Lactuca Canadensis*)

(28 *Bitter Thistle*, *Silybum Marianum*.)

(29. *Cardus benedictus*, *Cnicus benedictus*.)

92. *Coltsfoot*, *Tussilago Farfara*, an ingredient in Catarrh Snuff.

LOBELIACEAE. — 30 *Lobelia*, *Lobelia inflata*, used in practically every disease as an emetic, etc, the sheet anchor of the Thomsonian system.

ERICACEAE. — 31 *Pipsissewa*, *Chimaphila umbellata*

93. *Wintergreen*, *Gaultheria procumbens*, useful for diseases of the Urinary organs, dropsy, cancers and scrofula. The whole plant. Young plant used in making Spice Bitters.

94. *Uva Ursi*, *Arctostaphylos Uva-ursi*, for Inflammation of the Kidneys

95. *Cranberry*, *Vaccinium* different species The juice made into a drink in Typhus Fever and Inflammation of the Liver.

PLANTAGINACEAE. — 96. *Plantain*, *Plantago major*, the wilted leaves applied in Erysipelas

SCROPHULARIACEAE — 32 *Balmoney* or *Bitter Root*, *Chelone glabra* in very wide use. (See also No 126 below.)

(34 *Mullen*, *Verbascum Thapsus*)

PLUMBAGINACEAE. — (33. Marsh Rosemary, *Statice Limonium*)

VERBENACEAE — 35 *Blue Vervine*, *Verbena hastata*, ' tonic and emetic, good in ague and fever and coughs "

(36. *White Vervine*, *Verbena urticifolia*.)

LABIATAE. — 37. *Spearmint*, *Mentha viridis*, "diffusible stimulant, diuretic and aromatic, makes a good drink in colds and inflammatory diseases. The oil relieves piles."

38. *Peppermint*, *Mentha piperita*, "stimulant and aromatic, makes a fine stimulating drink for cold; essence on sugar relieves pain in stomach and bowels."

39. *Pennyroyal*, *Hedeoma pulegioides*, "stimulant, aromatic and emmenagogue."

(40. *Summer Savory*, *Satureia hortensis*.)

(41. *Horehound*, *Marrubium vulgare*.)

97. *Sage*, *Salvia officinalis*, used for making a tea, useful in pleurisy, inflammation of the bowels and measles.

98. *Origanum*, *Origanum Majorana*, oil used in inflammatory and chronic rheumatism, an ingredient in Rheumatic Drops and Liniment.

99. *Rosemary*, *Rosmarinus officinalis*, used in making Rheumatic Liniment.

100. *Scullcap*, *Scutellaria lateriflora*; an ingredient in Wine Bitters, stimulating Tea, Nerve Powder, given as a drink in Lockjaw and Fever.

101. *Balm*, *Monarda didyma*, made into a tea (Oswego tea), for inflammation of the Lungs.

102. *Dandelion*, *Taraxacum Dens-leonis* (called *Leontodon Taraxacum* in this work), the inspissated juice administered in Dropsy, Jaundice, Hypochondria and Complaints of the Liver

103. *Catnip*, *Nepeta Cataria*, produces sweating and expels wind, a valuable medicine for children.

BORRAGINACEAE.—104. *Comfrey*, *Symphytum officinale*; used as an ingredient in making Pulmonary Balsam.

SOLANACEAE—42. *Capsicum*, *Capsicum annuum*, used almost universally.

43. *Bitter Sweet*, *Solanum Dulcamara*, an ingredient in Nerve Ointment.

APOCYNACEAE — 105 *Indian Hemp*, *Apocynum cannabinum*, “diuretic, slightly laxative and antispasmodic, good in dropsy, the extract is said to cure fits and promote the absorption of tumors. relaxing and quieting to the system.”

ASCLEPIADACEAE—44. *Milkweed*, *Asclepias* (*Syriaca* it is called in this work) “it promotes perspiration and urine, good in gravel dropsy fever and inflammations”

106 *White root* or *pleurisy root*, *Asclepias tuberosa*, an ingredient in Cough or Fever Powder and given in Dropsy of the Chest, Apoplexy, Bleeding from the Stomach, Inflammation of the Stomach, Low Fever, etc.

ARISTOLOCHIACEAE — 45. *Snakeroot*, *Asarum Canadense*, “the root is aromatic and stimulating, loosens the lungs and vomits, the leaves are bitter and cause sneezing.”

107. *Virginia Snakeroot*, *Aristolochia serpentaria*, “sweating and strengthening.”

CHENOPODIACEAE.—108. *Wormseed* or *Oak of Jerusalem*, *Chenopodium ambrosioides*, var. *Anthelminticum* is meant.

(*C. Botrys* is more usually known as Jerusalem oak however.) The flowers, seed or oil used as an anthelmintic.

POLYGONACEAE.—46. *Yellow Dock*, *Rumex Crispus*, poultice for Tetters, Cancer and Itch; also used in making alterative Syrup.

109. *Smartweed*, *Polygonum aviculare* (*P. punctatum* in this work), "stimulates, equalizes the circulation and prevents mortification, an effectual fomentation for bruises and inflammations."

LAURACEAE.—110 *Sassafras* (called in this work *Laurus sassafras*), *Sassafras officinale*, used in making Tonic Composition, Alterative Syrup and Strengthening Plasters; "good for rheumatic, scrofulous and eruptive diseases, The bark of the root. The pith infused in rose water makes a fine eye water."

URTICACEAE.—47. *Slippery Elm*, *Ulmus fulva*, used as mucilaginous drink, also bark powdered dry.

111 *Hops*, *Humulus Lupulus* made into a decoction and applied as a wash, a fomentation in White Swelling. Spasms, Convulsions, Inflammation of Kidneys, Stomach or Bowels, Pleurisy, etc.

JUGLANDACEAE.—(48. *Butternut*, *Juglans cinerea*.)

112. *Hickory*, *Carya alba*, the lye evaporated to dryness and pulverized, used "to remove Fungous Flesh, Fistules, Cancers, etc."

CUPULIFERAE.—113 *White Oak*, *Quercus alba*, bark for astringent decoctions and plasters, also an ingredient in Dysentery Powder

114. *Red Oak* *Quercus rubra* the lye from the bark boiled down and made into a plaster for Cancer (Gallnuts or Nutgalls may also be mentioned here an ingredient in Pile Ointment).

115. *Beech*, *Fagus ferruginea*, wilted leaves applied in Erysipelas.

MYRICACEAE.—49. *Bayberry* or *Candleberry*, *Myrica cerifera*, used very extensively.

50. *Meadow Fern*, *Comptonia asplenifolia* (See No 116.)

116. *Meadow Fern*. This name is in this work given to the Sweet Gale, *Myrica Gale*, which is said to be "healing and purifying. An ointment made from the burs, cures Itch, Saltrheum and Tetters, and the decoction may be drunk."

BETULACEAE.—51. *Black Birch*, *Betula lenta*; used as an ingredient in the Tonic Composition and Cholera Syrup

SALICACEAE.—52. *White Poplar*, *Populus alba*.

53. *Stinking Poplar*, *Populus balsamifera*. [Note.—The species is not mentioned in this work; “poplar” is widely prescribed.]

(54. *Balm of Gilead*, *P. balsamifera*, var. *Canadensis*.)

CONIFERAE.—55. *Balsam Fir*, *Abies balsamea*.

56 *Hemlock*, *Abies Canadensis*: Bark an ingredient in Dysentery Powder, Rheumatic Drops and Tonic Composition as an Astringent and for topical application in Inflammatory Rheumatism.

117. *Cedar*, *Thuja occidentalis*, given for Rheumatism. (See No. 128 below.)

ARACEAE.—57. *Skunk Cabbage*, *Symplocarpus foetidus* (called in this work *Ictodes foetida*), “Good for Coughs, Asthma, Spasms and Worms.”

118. *Wild Turnip*, *Arisaema triphyllum*, an ingredient in Pulmonary Balsam, and used as an expectorant in Inflammation of the Lungs.

ORCHIDACEAE. — 119. *Lady's Slipper*, *Cypripedium pubescens* an ingredient in the Bread of Life (anti-dyspeptic conserve), the root is an ingredient in the Nerve Powder, a tea made from it is administered in simple Inflammatory Fever and Locked Jaw.

120. *Crawley Root*, *Corallorhiza odontorhiza*, “a nervine and antispasmodic, the roots with white root, cayenne and lobelia make an excellent fever powder”

LILIACEAE.—58. *Wake Robin*, *Trillium erythrocarpum*, used in making Cough or Fever Powder.

121. *Beth*, *Trillium latifolium* (says this work), an ingredient in the Female Restorative and given in Uterine Hemorrhage, etc., “a good astringent and tonic, useful for debility, coughs, fluor albus, etc. The root.”

122. *Unicorn*, called in this work *Helonias dioica*, probably *H. bullata*, an ingredient in Mothers' Relief, Wine Bitters, Female Restorative, administered for Chlorosis, etc.

123. *Solomon's Seal*, *Polygonatum giganteum* (called *P. multiflorum* in this work, but that species is cultivated), “strengthening, excellent in female weakness. The root.” (See No. 127 below.)

GRAMINEAE.—124. *Oats*, *Avena sativa*, a fomentation for pleurisy.

FILICES.—125. *Brake*, *Pteris aquilina*, used in making Nerve Ointment.

The identification of the above species is fairly certain, but there are some plants named in this work which are difficult to identify.

Queen of the Meadow is probably Thoroughwort or Boneset, *Eupatorium perfoliatum*.

126. *Culver's Physic* or *Black root* is probably *Veronica Virginica* of the Figwort Family. It is dried and pulverized and with partially evaporated ox-gall made into Bile or Peristaltic Pills.

127. *Saffron* is probably the American saffron, *Colchicum autumnale*, of the Lily Family; made into a drink for Measles.

128. *Juniper* is probably *Juniperus communis*, of the Cypress family of Conifers. The berries are given as a diuretic in cases of Strangury.

In exotic plants, in addition to bitter almonds, ginger, black pepper, cloves and myrrh, mentioned in the earlier work, this work mentions copaiva, aniseed, cinnamon, allspice, guaiacum, Peruvian bark, liquorice root

Vegetable products named are lye, sugar, molasses, vinegar, sweet or olive oil, castor oil, Indian meal, bread, camphor, rice, white turpentine, spirits of turpentine, Burgundy pitch, resin, India rubber, lemon juice, metheglin, charcoal, yeast, burnt sponge, and spunk (applied burning to a cancer to induce suppuration).

Animal products are not unknown, milk, buttermilk, salt butter, honey, bees' wax, a tea made of the honey bee (recommended as a diuretic in case of stone, strangury, etc.), lard, mutton tallow, oxgall, deer's horn, and a few mineral products, lime (quick and slaked), lime water, prepared chalk, chloride of lime, caustive (caustic) potash, sulphur, magnesia, Glauber's salts, alum, ammonia, sal ammoniac, saltpetre, nitrous ether, cream of tartar, calcined oyster shells, sulphuric acid, copperas, soda, salaratus; while alcohol, brandy and gin are used, the former two as a remedy for poisoning by essential oils and in making Improved Rheumatic Drops; the gin as a diuretic.

HYDRILLA VERTICILLATA, CASPARY, IN GREAT BRITAIN.

By ARTHUR BENNETT, A.L.S.

(Read 14th January 1915.)

In July Mr. W. H. Pearsall sent me a box of aquatics from Estwaite Water, Lancashire. Among them I was glad to find *Najas flexilis*, Rostk. et Schmidt (an addition to the English flora) along with *Potamogeton obtusifolius*, Mert. et Koch, *pusillus*, L. and *crispus*, L., *Callitriche autumnalis*, L., and a plant which seemed to answer to the above, but I wished the name confirmed, and sent it to Kew, Mr. N. E. Brown replied, "*Hydrilla verticillata*, an interesting find", and to the British Museum, whence Mr Wilmott wrote, "*Hydrilla verticillata* certainly."

It is a close ally of *Elodea canadensis*, and many botanists consider that the genera *Anacharis*, *Elodea*, and *Hydrilla* should be combined and form one genus.

It differs from *Elodea* in having "only one leaf to the spathe," but this character is not easily observed. Our plant seems to give few winter-buds which throw out roots, the stem being slender, with opposite leaves and short internodes, the leaves dark green in colour, these are succeeded by longer internodes, with the leaves linear-acuminate in threes and fives (or occasionally in fours), the uppermost leaves being whorled, pellucid the whole plant is paler and more pellucid than *Elodea*. If the figure in English Botany, ed. 3, t 1446 (1869) of the leaf margin is correct, then I think *Hydrilla* differs by the marginal transparent cells, which are extra-marginal and can hardly be called serrations.

The leaves are acute, narrower than *Elodea*, and the habit of the plant is much more gracile, and does not grow in the masses (at least in England) that *Elodea* does.

Mr. Pearsall observes. "The plant is very scarce; it never grows with *Elodea*, but almost invariably I get a plant or two (at most) among a mass of *Najas* and *Callitriche*. The depth of water it grows in is from 6 to 8 feet. It is recognisable at a glance. the leaves are usually in fives or threes, lighter in colour, and more acute at the apex; the

whorls are farther apart, and the stem is not red where they branch off, as in *Elodea*."

It has been variously named as under:—

Hydrilla verticillata, Caspary, in Bot. Zeit., xiv, 899 (1856).

H. ovalifolia, Rich., Mém. Inst. Paris, ii, 76, t. 2 (1814).

H. dentata, Casp., Bot. Zeit., xi, 805 (1853).

Udora verticillata, Gorski in Eichwald. Skizze v. Lithuan, etc., 127 (1830).

U. lithuanicus, Besser, in Flora, ii, Beibl. 12 (1832)

U. occidentalis, Koch, Syn. Fl. Germ., ed i, 669 (1837).

U. pomeranica, Reichb., Icones, f. 104 (1845).

? *Serpurula verticillata*, L.f. supp. plant., 416 (1781).

Asch. und Graeb., Syn. Milleleup. Fl., i, 399 (1897).

In Europe it occurs near Stettin in Pomerania, S.E. Prussia, Russia—in Wilna, Finland and Witsbk governments, in Asia, Central Africa Madagascar, Mauritius, and Australia.

How far the species is really indigenous to Europe is doubtful. Mr. Pearsall considers that the richness of the "Water" in aquatic vegetation is the result of the large number of aquatic birds that occur there. "wild ducks, coots, water-hens, etc., by the score" But it seems hardly possible that seeds could be conveyed from such far distant places, perhaps on the mud of the feet?, but I doubt in the crops, as Danish naturalists have determined that birds on migration *as a rule* fly with empty stomachs, and several that a friend of mine dissected in the spring migration to England had done the same.

ADDITIONAL MOSSES FROM DUNCRAIG, WEST ROSS-SHIRE

By JAMES STIRTON, M.D., etc.

(Read 8th April 1915)

For several years I have been considerably exercised in the study of a peculiar, almost unique, group of mosses the area of whose growth and spread is rather restricted. This area forms a narrow belt from north to south, extending from the Island of Lewis to the south of Ireland and from the west coast of Scotland to the Outer Hebrides. In the

Annals of Scottish Natural History¹ I have already spoken of the similar, or rather of the almost identical, habitats of other two remarkable mosses, viz. *Myurium Hebridarum* (Sch.) and *Hedwigidium imberbe* (Smith). Since then the latter of these two has been found in Scotland where it had previously been long sought in vain. The first station is close to Loch Awe, and in 1905 near Arisaig three others in rather close series were found. Besides these, two others might be associated with them, viz. *Campylopus Shawii* (Wils.) and *Glyphomitrium Daviesii* (Dicks.), the former confined strictly within the limits, the latter diverging a little towards the east, as on Bowling Hills, etc., but reaching Wales and extending, although sparingly, to the Island of Lewis.

I might have added others by way of strengthening my views of the peculiar part played in the world's history by this peculiar strip of land, but sufficient has been stated for my present purpose. I now revert to the group which plays the most important part in this respect.

This group may fairly well be placed under one genus, as Dr. Braithwaite has done, viz. under *Leptodontium* at p. 255, vol. i, of his work on British Mosses

- Leptodontium flexifolium* (Dicks.).
- „ *recurvifolium* (Tayl.).
- „ *gemmascens* (Mitt.).
- „ *terrenum* (Stirn.).
- „ *Rossii* (Stirn.).

The first moss has been known for more than a century, and its area of growth is accordingly more extended as it has been detected in two places on the continent of Europe, but by far the main sources of supply are the western parts of Great Britain. It is the only member hitherto found in fruit. It is also much smaller than the others, but its structure, as viewed under the microscope, connects it rather closely to the rest of the group; the second has been known for more than half a century, and remained for many years the only instance of its class; the third differs widely from the rest inasmuch as it produces propagula at the apices of the leaves much as in *Ulota*

¹ Ann. Scot. Nat. Hist., 1907, p. 42.

phyllantha (Brid.). It is, however, otherwise barren. Accordingly, I had doubts from the first of its claims to rank as a member of this group. A closer examination of its minuter structures has confirmed my resolution to reject it from association with the others. Besides, its only habitat hitherto known, viz. the straw-thatch of the older and smaller cottages, is certainly adverse to such an association. The area of growth—from the English Channel on its eastern side to the Frith of Tay—is also adverse to such a connection. Lastly, the shape of its leaves, sharply lanceolate, militate the most against it as well as the difference in their areolation. The fourth of this series, described in the *Annals of Scot Nat Hist.* for July 1900,¹ as well as in one or two other parts of the same magazine, is mainly characterised by the leaf in its upper third being abruptly as well as convexly narrowed to rather less in breadth than a half of the lower or broader part but still showing the pagina on each side of the narrowed nerve which can be traced to within a short distance of the broad round apex.

The fifth of the series was only discovered in October 1914 near Blairmore on the Frith of Clyde. The following is its description:—

Leptodontium Rossi (Stirn).—In rather large lax somewhat convex tufts of a deep or bluish green colour above, changing abruptly below to a dirty pale colour, stems strong upright, simple, or at times dichotomously divided, rarely fastigiately branched above, from an inch to an inch and a half long, leaves clasping stem, rather laxly arranged around it, curled inwardly in upper half or crisped when dry, spreading widely or even recurved (outwards) when wet, ovate oblong, smooth throughout or not papillose, margin plane, serrate in upper half with intermediate lesser serratures (or less pronounced) in lower third serratures much less or nearly vanishing, nerve strong, latit. near base .07-.08 mm., smooth throughout, tapering upwards and vanishing rather abruptly about .09 mm. from blunt and rounded apex, which is strongly and equally serrated without any apiculus such as are seen in the other three members of the group; central basal cells large, oblong,

¹ *Ann. Scot. Nat. Hist.*, 1900, p. 176.

attached with broad hyaline, characteristic walls, $\cdot 05$ – $\cdot 07$ by $\cdot 02$ – $\cdot 032$ mm., thickly granular but soon showing a tendency to become hyaline and then in double layer, such cells outwardly, rather abruptly narrower and hyaline, upwards cells soon bluntly quadrate but still showing the broad hyaline walls, $\cdot 02$ – $\cdot 027$ mm. in longer diameter, near margin and upwards to apex cells somewhat smaller and showing within minute particles well defined, which present much the appearance of stereids

Now, if the three larger species of this group are placed closely alongside one another in a wet state, they present mutual appearances of such a character that the eye alone is sufficient to discern a close general affinity. A closer inspection through a field lens confirms this view. Under a moderate power of the microscope the configuration of the leaves, the peculiar arrangement of the marginal serratures, the rather unusual disposition of their upper divisions, etc., point to a common origin. Inspected more closely under a higher power, the minuter structures and configurations show manifest differences in each to such an extent as fully to warrant specific distinction

As all this is merely preliminary to what I may have to say in another communication, I shall desist meanwhile from asserting conditions necessary to what may be called a theory, such as is shaping itself, as time goes on, more definitely in my mind.

While searching for specimens of *Leptodontium gemmascens* (Mitt.) on the old thatched roofs of the highland cottages, its usual habitat, I came across another moss which had, to the best of my recollection, not been previously observed, viz. —

Campylopus obtectus, sp. n. — In dense broadly expanded convex tufts of a vivid green above, in thickness about one-eighth to nearly a quarter of an inch, below this abruptly changing to a pale yellowish colour; stems upright generally single, but occasionally emitting short lateral branches; leaves closely appressed to stem when dry, slightly spreading but straight when wet, closely arranged around stem, broad, short and bluntish at apex ($\cdot 05$ mm. broad), which has two or three teeth but none elsewhere throughout leaf; nerve broad, nearly half that

of base, tapering upwards and ceasing a little below apex by the breadth of two or three cells; margin plane entire, incurved in upper half so as to render leaf hollow; no auricles at base properly so called, but cells there next nerve large, oblong attached, hyaline but with *thickish* walls, '045-'065 by '018-'025 mm., outwards on the same level cells about half the breadth, also hyaline, upwards lessening until the rhomboid chlorophyllose prevail to apex, a little longer at first, soon ending above into the smaller, '01-'013 by '007-'01 mm. Near Plockton, September 1914.

The next moss was discovered in 1913 near Plockton, but although I searched the same locality closely next year, only a few capsules, not quite ripe, were secured.

This is a very singular moss, and I am not yet quite certain that its systematic place has been determined.

In large, lax, convex extended tufts of a deep or livid green colour above, turning in time to a lighter green, dark brown below, stems upright from an inch to an inch and a half long, slender, simple or sparsely dichotomously divided. leaves laxly or distantly arranged around stem or from three to four in a complete whorl, spreading when wet, slightly crisped or rather hooked anteriorly in the upper half when dry, rather broadly ovate below, lanceolate above and acute, nerve strong, pale then a deep red, broad below, latit. near base, '11-'16 mm., tapering to apex, which it reaches or very nearly so, margin entire but broadly recurved near base, as much as '04 mm., narrowing upwards to near apex, strongly papillose as well as pagina: alt. of papillæ, '003-'005 mm.; leaves hyaline becoming slightly granular upwards, cells at base long, undulating or even sinuose on margin, narrowly oblong, rather widely apart, becoming brown as well as the whole leaf, when also the undulations are nearly obliterated, '04-'06 by '005-'007 mm., showing connecting tubes and pores with neighbouring cells, merging upwards into shorter broader cells, apart, granular, '02-'03 by '007-'009 mm., ultimately passing upwards into roundish cells with irregular walls, showing bright points in a dark ground, '009-'014 mm. in slightly longer diameter; seta long, slender, smooth, undulating with a wider deeper

bend next capsule dark-red; capsule often nearly pendulous owing to the wide bend of seta, long, straight, cylindrical or slightly broader below, brown, operculum concolorous also slender, upright, long, more than half the length of capsule. This moss, although nearly ripe, is too young to show peristome, and yet the columella within capsule is fairly well defined throughout and is also slender. On earth covering rocks in the old, probably primeval, forest of Duncraig near Plockton.

As already stated, there are several peculiarities in this moss, but there are two that stand out more prominently, viz the areolation which approaches in several respects that of a section of *Racomitrium* while its external and more obvious appearance is otherwise quite at variance with any of the species of that genus. The seta is also curiously bent or rather geniculate below the apothecium, not unlike that of *Campylostelium*. I am so impressed with these differences that I am inclined, even in the absence of the peristome, to put it under a new genus and call it *Limneria viridula* (gen. nov.)

Another curious and beautiful moss has been under observation for several years. I have waited in expectation of finding it in fruit, but in vain. It grows in several places on the west coast of Scotland, but most luxuriantly near the base of the famous Duncraig forming the highest and most precipitous rocks of their kind in Great Britain. It possesses characters in common with three genera, viz *Pohlia*, *Bryum*, and *Mnium*. Meanwhile I have inserted it under *Bryum*. I have no scruples, as I have had in other instances, in describing it in a barren condition as the external characters are so obvious and well marked as to render it easily discernible even in the field.

Bryum intortulum, n. sp. — In rather extended lax tufts of a bright green colour above, abruptly showing below, at first sight, merely dense masses of tomentum of a beautiful port-wine colour, covering and almost concealing the rest of the plant. stems slender, upright, about an inch and a half long, in other instances, with male inflorescence alone, twice this length, pale at first afterwards red, emitting nearly at right angles, rather frequently, short branches, leaves laxly disposed around the stems, long, spreading widely in a wet

state, straight, narrowly ovate-lanceolate, the apex very acute and rendered shortly acuminate by the excurrent slightly denticulate nerve, in a dry state spirally twisted or rope-like from three to four complete rounds giving the leaf the appearance of a large, long, straight, sharp-pointed spine at an angle from the stem about 50 degrees, margin of leaf entire, composed of from four to seven rows of very long narrow cells up to apex, where they join the excurrent, slightly denticulate nerve, reflexed from base as much as .05 mm., narrowing upwards but extending up three-fourths whence the margin becomes plane; nerve strong, red for a short distance at base, where latit. is .07-.1 mm, upwards pale, narrowing to apex, cells in the lowest fourth of leaf large, oblong, attached with thickish opaque walls, .075-.09 by .022-.027 mm, upwards lessening until they become oblongo-hexagonal to apex, .04-.05 by .015-.022 mm, barren.

As I have already stated elsewhere this craig is engaging my attention in another direction. On its plant-life is very varied, and such that I have not hitherto found a parallel to it on any part of the west coast.

THE SCOTTISH ALPINE BOTANICAL CLUB EXCURSION,
1914 By ALEXANDER COWAN.

(Read 10th June 1915)

The members met on 20th July at the Ogilvy Arms Hotel, Kirriemuir, which they made their headquarters, as they were unable to obtain suitable accommodation at the hotel at Clova, and though this was some distance from the ground proposed to be visited, the fact of motor transport being now available materially reduced the inconvenience caused and the time lost, as in the old days when horse-drawn vehicles had to be used.

On 21st July they motored up Glen Clova, intending to botanise in Glen Fee, which they had visited on previous occasions without special leave having been asked for. On arrival, however, at the shooting-lodge they were informed by the stalker that the ground was strictly preserved and that the party could on no account visit it for

botanical purposes; the members, therefore, had no alternative but to make their way up the public path leading through Glen Dole in order to botanise in this valley and beyond.

The day was fine and warm up to 2 o'clock, when distant thunder was heard and was soon succeeded by heavy rain, so that the whole party got more or less wet.

The two members who visited the station for *Lychnis alpina*, which they were lucky enough to find, got wet to the skin, as there was no shelter of any kind available. However, the storm was succeeded by a warm sun, and this, together with the long walk back to the shooting-lodge, helped to dry the clothes and revive the spirits of the party, so that none were any the worse. The rocks in this valley were disappointing on the whole; still, the following plants were found:—

Cochlearia alpina, Wats.; *Dianthus deltoides*, Linn.; *Lychnis alpina*, Linn.; *Silene acaulis*, Linn.; *Lathyrus macrorrhizus*, Winn.; *Vicia sylvatica*, Linn.; *Saxifraga aizoides*, Linn.; *S. oppositifolia*, Linn.; *Sedum Rhodiola*, DC.; *Epilobium anagallidifolium*, Lam.; *E. angustifolium*, Linn.; *Cornus suecica*, Linn.; *Antennaria dioica*, Br.; *Carduus heterophyllus*, Linn.; *Solidago Virgaurea*, Linn.; *Trientalis europaea*, Linn.; *Plantago media*, Linn.; *Carex aquatilis*, Wahl.; *C. curta*, Good. var. *alpicola*; *C. Oederi*, Retz.; *C. pallescens*, Linn.; *C. rigida*, Good.; *C. stellulata*, Good.; *Selaginella selaginoides*, Gray; *Lastrea abbreviata*, Newm.; *Polypodium Dryopteris*, Linn.; *P. Phegopteris*, Linn.; *Polystichum Louchitis*, Roth; *Pseudanthyrium alpestre*, Newm.

On Wednesday, 22nd July, the party motored as far as the hotel at Clova and spent the day in the neighbourhood of Loch Brandy. Nothing very rare was found here on the rocks, as they are dry and barren, but several interesting things were got in and near the loch, on the screes and higher ground visited. The weather was everything that could be desired. The following is a list of the plants found:—

Subularia aquatica, Linn.; *Cerastium alpinum*, Linn.; *Hypericum humifusum*, Linn.; *Potentilla maculata*, Pourr.; *Rubus Chamaemorus*, Linn.; *Saxifraga aizoides*,

Linn.; *S. stellaris*, Linn.; *Sedum Rhodiola*, DC.; *Callitriche aquatica*, Huds.; *Epilobium alpinum*, Linn.; *E. palustre*, Linn.; *Cornus suecica*, Linn.; *Galium boreale*, Linn.; *Lobelia Dortmanna*, Linn.; *Arctostaphylos Uva-Ursi*, Spreng.; *Loiseleuria procumbens*, Desf.; *Littorella lacustris*, Linn.; *Salix herbacea*, Linn.; *Juncus trifidus*, Linn.; *Sparganium natans*, Linn.; *Carex ampullacea*, Good.; *C. curta*, Good.; *C. pulicaris*, Linn.; *C. rigida*, Good.; *C. stellulata*, Good.; *Isaetes lacustris*, Weig.; *Lycopodium alpinum*, Linn.; *L. clavatum*, Linn.; *Polypodium Dryopteris*, Linn.; *P. Phegopteris*, Linn.

On Thursday, 23rd July, the party motored up Glen Prosen, a valley lying to the west of Glen Clova, which had never previously been visited by the Club. The road leads past the well-known farm of Spott, famous for its black-faced sheep.

After leaving the motor, there is a walk of four to five miles on a rough track, alongside the Prosen water, to the head of the glen, where there is a considerable quantity of rocks and scree but these were very barren of alpine plants. Plenty of ferns were, however, met with, and one of the members was fortunate enough to find a crested form of the Holly Fern. The day was fine until 1 o'clock, when heavy showers came on and continued at frequent intervals till 4 o'clock, after which it remained fine. The following plants were found:

Thalictrum alpinum, Linn.; *Saxifraga hypnoides*, Linn.; *S. oppositifolia*, Linn.; *S. stellaris*, Linn.; *Saussurea alpina*, DC.; *Solidago Virgaurea*, Linn.; *Carex atrata*, Linn.; *C. pallescens*, Linn.; *C. pilulifera*, Linn.; *C. pulicaris*, Linn.; *C. rigida*, Good.; *C. stellulata*, Good.; *Asplenium Trichomanes*, Linn.; *Polystichum aculeatum*, Roth; *P. Lonchitis*, Roth; *Pseudathyrium alpestre*, Newm.

The members returned home on Friday, 24th July.

It was a great disappointment that entrance to Glen Fee was forbidden, as it was found afterwards that leave to botanise there could have been obtained by writing beforehand, had the Club known that this was necessary. On previous occasions no one had ever interfered with the movements of the party in this locality.

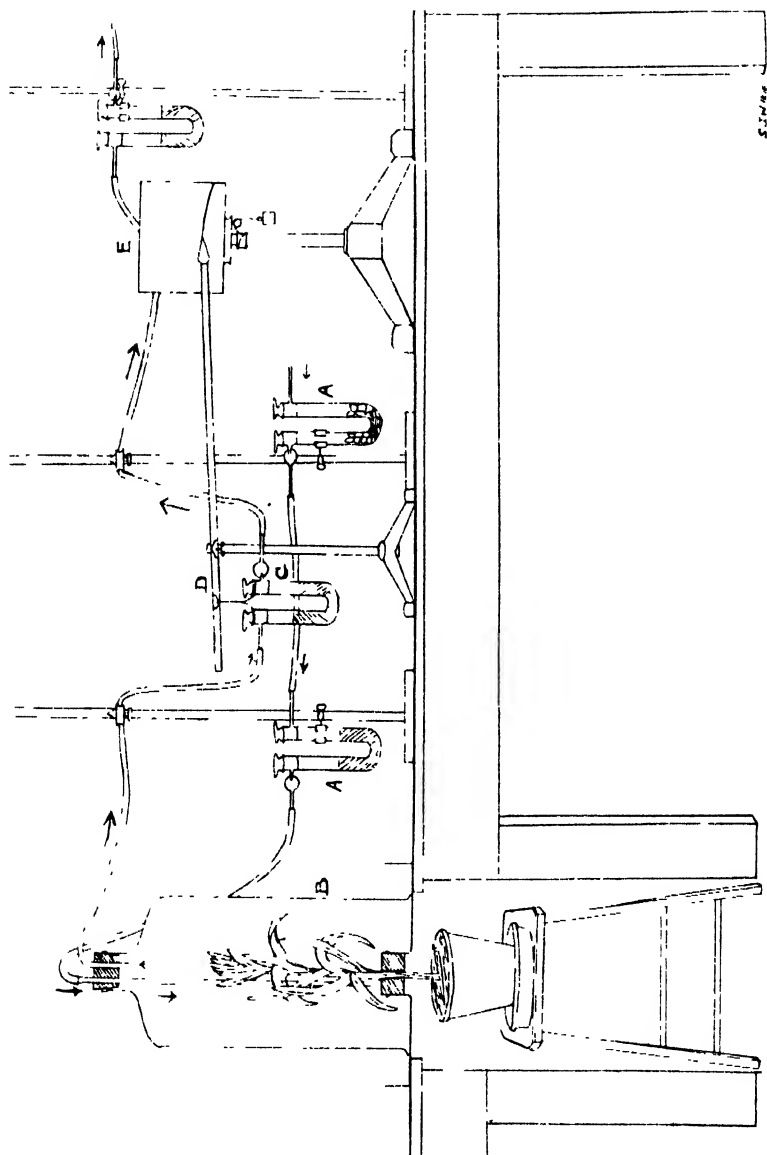
A NEW METHOD OF CONTINUOUS AUTOMATIC REGISTRATION OF TRANSPIRATION. By R. A. ROBERTSON, M.A., B.Sc., and S. J. WILKIE, B.Sc. (Carnegie Research Scholar, St. Andrews). (Plate LVIII.)

(Read 10th June 1915.)

For a research in hand on Transpiration Periodicity it was found necessary to obtain continuous automatic records extending over periods of some duration. The ordinary automatic method of weighing the plant and making the necessary correction was inconvenient, while other methods entailing interruption for direct observation at short intervals were obviously of little use in this case. The illustration shows the apparatus devised which has yielded satisfactory results.

The principle of the method is that the vapour transpired is automatically trapped, weighed, and a record taken on a rotating drum, from the data thereby available continuous graphs can be constructed for lengthy periods. Dry air is passed into a receiver containing the transpiring material, the outgoing air is passed over calcium chloride, and the aqueous vapour is measured. The air is drawn continuously through the closed system by an aspirator pump, the pressure of which is regulated by manometer. The air is drawn through (A), a tube of chloride, where it is dried, thence through (B), a glass receiver, in which is the transpiring material. The humid air from the receiver next passes through (C), the index tube of chloride. This tube is counterpoised on the arm of the lever (D), the other arm of which makes a tracing on the smoked paper on the drum (E) which makes one revolution per twenty-four hours. The counterpoising is made as delicate as possible, the chloride is renewed once per day, with the minimum of interruption. The tubing used to link up the system is of very flexible rubber, and every care is taken to prevent it becoming hard. Condensation of vapour on the glass receiver is obviated by accurate regulation of the rate of aspiration and by keeping the temperature constant.

Satisfactory continuous records extending over twelve to thirty days have been made for herbaceous plants, succulents, and needle-leaved Gymnosperms without appreciably damaging the experimental material.



ROLL

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Corrected to April 1917.

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HIS MOST GRACIOUS MAJESTY THE KING.

HONORARY FELLOWS.

BRITISH SUBJECTS (LIMITED TO SIX).

Date of Election

- Nov. 1896 BAKER, J. G., F.R.S., F.L.S., 3 Cumberland Road, Kew.
 Nov. 1888. DYER, SIR WILLIAM TURNER THISELTON, M.A., LL.D., K.C.M.G.,
 C.I.E., F.R.S., *The Ferns, Witcombe, Gloucestershire.*
 Dec. 1907. FARMER, J. BRETLAND, M.A., F.R.S. *Professor of Botany, Imperial*
College of Science and Technology, 8 Kensington.
 Feb. 1911. MARSHALL, Rev. E. S., *West Monkton Rectory, Taunton.*
 Feb. 1912. SCOTT, Dr. D. H., M.A., LL.D., Ph.D., F.R.S., *Oakley, Hants.*

FOREIGN (LIMITED TO TWENTY-FIVE).

- June 1902. BONNIER, GASTON, *Professor of Botany, Paris.*
 June 1902. BRITTON, NATHANIEL LORD, *Director of the Botanic Garden, New*
York.
 June 1902. FARLOW, Dr. WILLIAM GILSON, *Professor of Cryptogamic Botany,*
Harvard, U.S.A.
 Feb. 1911. FLAHAULT, Dr. CHARLES, *Professor of Botany to the Faculty of*
Science, and Director of the Institute of the University,
Montpellier.
 Mar. 1895. SARGENT, CHARLES S., *Professor of Arboriculture, and Director*
of the Arnold Arboretum, Harvard, —Corresponding Member,
March 1878.
 June 1902. TIMIRJAZEW, Dr. K. A., *Professor of Botany, Moscow.*
 June 1902. TRELEASE, Dr. WILLIAM, *University of Illinois, Urbana, Illinois,*
U.S.A.
 Mar. 1895. VRIES, Dr. H. DE, *Professor of Botany in the University.*
Amsterdam.
 June 1902. WALDECK, Dr. ALEXANDER FISCHER VON, *Professor of Botany*
and Director of the Imperial Botanic Garden, Petrograd.
 Dec. 1885. WARMING, Dr. EUGEN, F.R.M.L.S., *Emeritus Professor, Copen-*
hagen.

RESIDENT AND NON-RESIDENT FELLOWS

No distinguishing mark is placed before the name of Resident Fellows who contribute annually and receive Publications.

** Indicates Resident Fellows who have compounded for Annual Contribution and receive Publications.*

† Indicates Non-Resident Fellows who have compounded for Publications.

‡ Indicates Non-Resident Fellows who do not receive Publications.

Date of Election.

- Dec. 1915. Adam, Robert Moyes, 17 *W. Brighton Crescent, Portobello.*
 Dec. 1906. Adamson, R. Stephen, M.A., B.Sc., *Botanical Department, University, Manchester.*
 Feb. 1905. †Aiken, Rev. J. J. Marshall Lang, B.D., *The Manse, Ayton, Berwickshire.*
 Nov. 1884. †Alexander, J. A., 24 *Lawn Crescent, Kew Gardens, London, W.*
 Nov. 1914. Alexander, J. H., 8 *Chamberlain Road.*
 Mar. 1915. Alexander, Miss A. S. M., B.Sc., *High School Stirling.*
 Dec. 1913. Anderson, Thomas, M.A., B.Sc., 21 *Granby Road.*
 Dec. 1908. †Balfour, F. R. S., 39 *Phillimore Gardens, Kensington, London, W.*
 May 1872. *Balfour, I. Bayley, Sc.D., M.D., F.R.S., F.L.S., *King's Botanist, Professor of Botany, and Keeper of the Royal Botanic Garden, Inverleith House, Edinburgh.*
 Dec. 1863. †Barnes, Henry, M.D., F.R.S.E., 6 *Portland Square, Carlisle.*
 Jan. 1905. *Bell, A. C. M. W.S., *East Morningside House, Clinton Road.*
 May 1891. *Berwick, Thomas, 56 *North Street, St. Andrews.*
 Dec. 1879. *Bird, George, *Woodlea, 109 Trinity Road.*
 May 1888. *Bonnar, William, 51 *Brax Avenue.*
 Jan 1899. *Borthwick, A. W., D.Sc., 46 *George Square.*
 Dec. 1886. *Bower, F. O., M.A., D.Sc., F.R.S., F.L.S., *Professor of Botany, University of Glasgow, 1 St. John's Terrace, Hillhead, Glasgow.*
 Jan. 1871. *Boyd, W. B., of *Faldonside, Melrose.*
 Feb. 1870. †Bramwell, John, M.D., 66 *Wilbury Road, Hove, Brighton.*
 April 1913. †Brebner, James, 2 *Scotswood Terrace, Dundee.*
 Dec. 1890. Brown, Richard, C.A., 23 *St Andrew Square, —TREASURER.*
 Dec. 1906. †Bryce, George, B.Sc., *Botanic Garden, Peradeniya, Ceylon.*
 Nov. 1894. Buchan-Hepburn, Bart., Sir A., *Smeaton Hepburn, Prestonkirk.*
 Dec. 1915. Cadman, Miss Elsie, M.A., B.Sc., 30 *Trinity Road.*
 Feb. 1882. Caird, Francis M., M.B., C.M., F.R.C.S.Ed., *Professor of Clinical Surgery, 13 Charlotte Square, —ARTIST.*
 Nov. 1905. Campbell, Robt., M.A., D.Sc., *Geological Department, University of Edinburgh.*
 Dec. 1858. †Carruthers, William, F.R.S., F.L.S., *Central House, Central Hill, London, S.E.*
 Feb. 1848. Christison, Sir Alexander, Bart., M.D., 40 *Moray Place.*
 June 1873. *Clark, T. Bennet, C.A., *Newmills, Balerno.*
 Dec. 1856. †Cleland, John, M.D., F.R.S., *Drumclog Cruikernie, Somerset.*
 May 1861. †Coldstream, Wm., B.A., I.C.S. (ret'd.), 69 *West Cromwell Road London, S.W.*
 April 1913. †Cooper, R. E., c/o Thos. Cook & Son, *Calcutta, India.*
 Mar. 1900. *Cowan, Alexander, *Valleyfield, Pencuik.*
 Feb. 1870. †Cowan, Charles W., *Dalhousie Castle, Madlothran*
 April 1909. Cowan, Robert Craig, *Eskhill, Musselburgh.*
 Mar. 1903. Cowie, William Beaverley, F.C.S., 26 *Clyde Street.*
 Dec. 1915. *Craib, W. G., M.A., *Royal Botanic Garden, Edinburgh.*
 Dec. 1866. *Craig, Wm., M.D., F.R.C.S.Ed., F.R.S.E., 71 *Bruntsfield Place.*
 Feb. 1874. †Crawford, William Caldwell, M.A., 1 *Lockharton Gardens, Colinton Road, —HONORARY CURATOR.*
 Dec. 1903. Davidson, J. Randolph, M.A., B.Sc., *School of Agriculture, Gizeh, Egypt.*
 Dec. 1911. †Davidson, John, *Botanical Office, University of British Columbia, Vancouver, Canada.*
 Feb. 1912. Davie, R. C., M.A., D.Sc., 22 *Queen's Avenue, Blackhall.*
 Dec. 1892. Day, T. Cuthbert, 36 *Hillside Crescent.*
 April 1914. Dodd, A. Scott, B.Sc., 20 *Stafford Street.*
 Jan. 1894. *Dowell, Mrs A., 13 *Palmerston Place*
 Dec. 1911. †Drummond, J. R., B.A., F.L.S., F.Z.S., 4 *Eversfield Road, Richmond, Surrey.*
 Dec. 1859. †Duckworth, Sir Dyce, Bart., M.D., LL.D., 28 *Grosvenor Place, London, S.W.*

Dates of Election.

- Dec. 1869. †Duthie, J. F., B.A., F.L.S., *c/o The Manager, Delhi & London Bank, Ltd., 5 Bishopsgate, London, E.C.*
- Dec. 1916. †Eley, Charles, *East Bergholt Place, Suffolk.*
- Nov. 1885. Elliot, G. F. Scott, M.A., B.Sc., F.L.S., *Drumwhill, Mossdale.*
- Jan. 1883. *Evans, Arthur H., M.A., 9 *Harvey Road, Cambridge.*
- Dec. 1905. *Evans, W. Edgar, B.Sc., 38 *Morningside Park.*
- Mar. 1890. Ewart, J. Cossar, M.D., F.R.S.S. L. & E., *Professor of Natural History, University of Edinburgh.*
- Feb. 1894. Ferguson, Sir R. C. Munro, K.C.M.G., of *Raith and Novar, Kirkcaldy.*
- July 1860. †Fox, Charles H., M.D., 35 *Heriot Row.*
- Feb. 1873. *France, Charles S., 13 *Cairnfield Place, Aberdeen.*
- Jan. 1906. *Fraser, James, 18 *Park Road, Leith.*
- July 1872. *Fraser, John, M.B., C.M., 54 *Great King Street.*
- Jan. 1903. Fraser, J. C., *Comely Bank Nurseries.*
- Mar. 1862. Fraser, Sir Thomas R., M.D., F.R.S., *Professor of Materia Medica, 13 Drumshugh Gardens.*
- Mar. 1871. *Gamble, James Sykes, M.A., F.L.S., *High Field, East Liss, Hants.*
- May 1874. †Geikie, Sir Archibald, LL.D., F.R.S.S. L. & E., *Shepherd's Down, Haslemere, Surrey.*
- Jan. 1887. *Gibson, A. H., 28 *Dalhousie Terrace.*
- May 1903. †Gilmore, Dr. Owen, L.R.C.P., L.R.C.S.E., 49 *Acre Lane, Brixton, London, S.W.*
- Dec. 1907. Gourlay, W. Ballfour, B.A., 4 *Coates Crescent.*
- Jan. 1889. *Grieve, James, *Redbras Nurseries, Broughton Road.*
- Dec. 1895. *Grieve, Sommerville, 21 *Queen's Crescent.*
- Feb. 1879. *Grieve, Symington, 11 *Lauder Road.*
- Nov. 1914. †Harley, Andrew, *Blinkbonny, Kirkcaldy.*
- April 1910. Harvey, Miss Elsie, 5 *Salisbury Road.*
- Jan. 1911. Hawick, Miss C. M., B.Sc., 10 *Derby Street, Leith.*
- Mar. 1913. †Hayward, Miss Ida M., F.L.S., 7 *Abbotsford Road, Galashiels.*
- April 1886. Hill, J. Ruthertford, Ph.C., *Secretary, Pharmaceutical Society, 36 York Place.*
- Feb. 1878. †Holmes, E. M., F.L.S., F.R.H.S., *Curator of Museum, Phar. Soc. of Great Britain, Ruthorn, Sevenoaks, Kent.*
- Feb. 1891. †Jamieson, Thomas, 10 *Belmont Street, Aberdeen.*
- Dec. 1907. *Jeffrey, J. Frederick, *Royal Botanic Garden, Edinburgh (19 Queen's Avenue, Blackhall).*
- Mar. 1905. †Joannides, Pericles, B.Sc., *Sporting Club, Ibrahimieh, Alexandria, Egypt.*
- May 1877. *Johnston, Henry Halcro, C.B., D.Sc., M.D., F.L.S., *Colonel R.A.M.C., Orphir House, Orphir, Kirkwall.*
- Dec. 1912. *Johnstone, James Todd, M.A., B.Sc., *Royal Botanic Garden, Edinburgh.*
- Jan. 1913. Kemp, Mrs Norman, M.A., D.Sc., 45 *East Trinity Road, Leith.*
- Jan. 1874. †Kirk, Robert, M.D., F.R.S.C.Ed., *Bathgate.*
- Dec. 1911. *Lamont, Miss Augusta, B.Sc., 73 *Falcon Road.*
- Jan. 1914. Latimer, Sydney, 2 *Hermitage Gardens.*
- Feb. 1888. †Learmouth, Wm, *Fleetview, Gatehouse of Fleet.*
- Feb. 1878. †Lennox, David, M.D., F.C.S., *Tayside House, Nethergate, Dundee.*
- Jan. 1895. MacDougall, R. Stewart, M.A., D.Sc., 9 *Dryden Place.*
- Jan. 1881. †Macfarlane, John M., Sc.D., F.R.S.E., *Professor of Botany, University of Philadelphia, U.S.A.*
- Feb. 1886. M'Glashan, D., 11 *Corrennie Gardens.*
- June 1880. *M'Intosh, W. C., M.D., LL.D., F.R.S.S. L. & E., L.F.S., *Professor of Natural History, St. Andrews.*
- Feb. 1914. Macpherson, Alexander, M.A., B.Sc., 5 *London Street.*
- April 1916. M'Pherson, Miss Beatrice Campbell, B.Sc., 110 *Holyrood Road.*
- Feb. 1914. Macpherson, Donald, M.A., B.Sc., 5 *London Street.*
- June 1897. †Macvicar, Symers M., *Invermoidart, Acharacle, Argyllshire.*
- Feb. 1914. Macwatt, John, M.B., C.M., *Morelands, Duns.*
- Oct. 1914. Martin, Isa, M.A., 1 *Hampion Place.*
- Jan. 1902. Massie, William Hall, *Redbras House, Broughton Road.*
- Mar. 1913. †Matthews, James R., M.A., *Birkbeck College, Breams Buildings, London, E.C.*
- Mar. 1910. †Millar, F. Grahame, *c/o The Tangga Batu Rubber Co., Malacca, S.S.*
- Feb. 1902. *Millar, R. C., C.A., 6 *Regent Terraces, —AUDITOR.*
- Jan. 1899. Morton, Alex., B.Sc., 23 *Morningside Grove.*

Date of Election.

- July 1878. †Muirhead, George, F.R.S.E., *Gordon Estates Office, Forchabers.*
 April 1916. †Nicholson, C., Esq., F.E.S., 35 The Avenue, Hale End, Chingford, Essex.
 Dec. 1876. *Norman, Commander Francis M., R.N., *Cheviot House, Berwick-on-Tweed.*
 Dec. 1907. *Orr, Matt. Y., 37 Dudley Crescent, Leith.
 Oct. 1914. †Patton, Donald, M.A., B.Sc., *Manse Villa, Pollok Road, Shawlands, Glasgow.*
 April 1888. *Paul, Rev. David, M.A., LL.D., *Carridale, Fountainhall Road,—FOREIGN SECRETARY.*
 April 1887. Peyton, Rev. W. W., *Braetiaich, Tan-y-Bryn Road, Llandudno, Wales.*
 Jan. 1915. Pinkerton, A. A., 19 Shandwick Place.
 June 1891. †Prain, Sir David, M.D., C.I.E., F.R.S.S. L. & E., F.L.S., *Royal Botanic Gardens, Kew.*
 July 1884. *Rattray, John, M.A., B.Sc., F.R.S.E., *Tullyburn Terrace, Glasgow Road, Perth.*
 April 1877. †Riddell, Wm. R., B.A., B.Sc. (Hon. Mr. Justice), *Osgoods Hall, Toronto, Canada.*
 Dec. 1869. *Robertson, A. Milne, M.B., C.M., *Havea, Rodway Road, Roshampton, London, S.W.*
 Dec. 1890. Robertson, Robert A., M.A., B.Sc., *Lecturer on Botany, Botanical Department, Bute Medical School, St. Andrews.*
 Feb. 1905. *Ross, A. J., M.A., B.Sc., *Schoolhouse, Gretna.*
 June 1898. Russell, D., *Cadham, Markinch.*
 Mar. 1902. Sampson, Hugh C., B.Sc., *Trichinopoly, Madras, India.*
 Jan. 1906. †Sanderson, Harry, *Eastmount, Galashiers. (*)*
 Dec. 1887. †Scott, J. S., L.S.A., 68 Clowes Street, West Gorton, Manchester.
 Feb. 1891. *Smith J. Pentland, M.A., B.Sc., *Brasdena, Lochwinnoch, Renfrewshire.*
 Nov. 1914. Smith, James L. S., M.A., B.Sc., 17 Cargill Terrace, Trinity.
 Dec. 1909. Smith, Wm. G., B.Sc., Ph.D., 9 Braidsburn Crescent.
 Jan. 1902. *Smith, W. W., M.A., *Royal Botanic Garden, Edinburgh (8 Dudley Terrace, Leith),—HONORARY SECRETARY.*
 Jan. 1890. *Somerville, William, M.C.D., B.Sc., F.R.S.F., *Sibthorpe Professor of Rural Economy, 121 Banbury Road, Oxford.*
 Oct. 1914. †Stewart, Edward J. A., M.A., B.Sc., 6 Manor Road, Jordanhill, Glasgow.
 Dec. 1916. †Stirling-Maxwell, Sir John, Bart., *Pollok, Pollokshaws.*
 Feb. 1902. Tagg, Harry F., F.L.S., *Royal Botanic Garden, Edinburgh.*
 Jan. 1913. †Tagg, M. H., 53 Clayton Avenue, Wembley, Middlesex.
 Dec. 1887. Terras, J. A., B.Sc., 40 Findhorn Place.
 Jan. 1909. Thompson, Miss Jean G., B.Sc., 19 Pentland Terrace.
 May 1888. *Trail, J. W. H., M.A., M.D., F.R.S., F.L.S., *Professor of Botany, Aberdeen.*
 Dec. 1886. Turnbull, Robert, B.Sc., *Board of Agriculture, 4 Upper Merrion Street, Dublin.*
 July 1886. †Waddell, Alexander, of Palace, Jedburgh.
 Feb. 1901. Whytock, James, *Dalkeith Gardens, Dalkeith.*
 Mar. 1898. †Wilkinson, W. H., F.L.S., F.R.M.S., *Dumorieff, Sutton Coldfield, near Birmingham.*
 Dec. 1890. *Wilson, John H., D.Sc., F.R.S.E., 89 South Street, St. Andrews :—Associate, Nov. 1886.
 Feb. 1912. Wilson, Malcolm, D.Sc., 31 Wardie Road, Trinity, temp. Donnabrook, 26 St. Augustine's Road, Canterbury.
 Mar. 1909. *Wilson, Thos., Ph.C., 110 High Street, Burntisland.
 May 1873. †Wright, R. Ramsay, M.A., B.Sc., *Professor of Natural History, University, Toronto.*
 May 1883. †Yellowlees, David, M.D., LL.D., 6 Albert Gate, Dowanhill, Glasgow.
 Jan. 1903. Young, William, *Fairview, Kirkcaldy.*

ORDINARY MEMBERS.

- Nov. 1910. Clark, Mrs. Bennet, *Newmills, Balerno.*
 Nov. 1910. Gourlay, Kenneth M., C.A., *Malleny, Balerno.*
 Nov. 1910. Grieve, Miss Jean E., 11 *Lauder Road.*

(*) Killed in action in France.

ASSOCIATES.

Date of Election.

- Mar. 1886. Bennett, A., 5 *Thanet Place, High Street, Croydon.*
 Feb. 1876. Campbell, A., 62 *Marchmont Road.*
 Feb. 1871. Evans, William, F.R.S.E., 38 *Morningside Park.*
 Jan. 1906. Harrow, R. L., *Royal Botanic Garden, Edinburgh.*
 June 1891. McAndrew, James, 69 *Spottiswoode Street.*
 Dec. 1883. Richardson, Adam D., 19 *Joppa Road, Portobello.*
 Jan. 1906. Stewart, I. B., 23 *Brandon Terrace.*

LADY MEMBERS.

- June 1893. Atken, Mrs. A. P., 15 *Victoria Mansions, West Hampstead, London, N.W.*
 April 1893. Balfour, Mrs. Bayley, *Inverleith House.*
 Feb. 1910. Galletly, Mrs. Sarah H., 71 *Braid Avenue.*
 April 1902. Grieve, Mrs. Symington, 11 *Lauder Road.*
 Jan. 1894. Pearson, Miss C. C., 27 *Royal Terrace.*

CORRESPONDING MEMBERS.

- Dec. 1905. Adamovic, Lujó, *Professor of Botany, and Director of the Botanic Garden, Belgrade.*
 Dec. 1905. Bailey, Fredk. Manson, F.L.S., *Colonial Botanist of Queensland, Brisbane.*
 Dec. 1905. Barboza, J. Casimiro, *Director of the Botanic Garden, Oporto.*
 Dec. 1905. Beijerinck, M. W., *Professor of Bacteriology, Delft.*
 Dec. 1881. Bohnensieg, Dr. G. C. W., *Conservator of the Library of the Museum Teyler, Haarlem.*
 Mar. 1881. Caminhoá, Dr. Joaquim Monteiro, *Rio de Janeiro.*
 Dec. 1905. Campbell, Dr. Douglas Houghton, *Professor of Botany, Stanford University, California.*
 Jan. 1886. Candolle, Casimir de, *Geneva.*
 July 1879. Cheeseman, T. F., F.L.S., F.Z.S., *Curator of the Museum, Auckland, New Zealand.*
 July 1879. Cleave, Rev. W. O., LL.D., *College House, St. Helier, Jersey.*
 Dec. 1905. Cockayne, L., Ph.D., F.R.S., 20 *Colombo Street, Wellington, New Zealand.*
 June 1902. Constantin, Dr. J., *Director, Jardin des Plantes, Paris.*
 Dec. 1905. Coulter, John Merle, *Professor of Botany, University of Chicago.*
 June 1902. Cramer, Dr. Carl Eduard, *Professor of Botany, Zürich.*
 Mar. 1895. Elfving, Dr. Fredrik, *Professor of Botany in the University, and Director of the Botanic Garden, Helsingfors.*
 Dec. 1905. Famintzin, Dr. André, *Emeritus Professor of Botany, and Director of the Botanical Laboratory of the Imperial Academy of Sciences, Petrograd.*
 Dec. 1905. Fawcett, William, B.Sc., F.L.S., 76 *Shooter's Hill Road, Blackheath, London, S.E.*
 Dec. 1905. Gravis, Auguste, *Professor at the University, and Director of the Botanic Garden, Liège.*
 Mar. 1885. Guignard, Léon, *Membre de Institut, Professor of Botany, Paris.*
 June 1902. Henriques, Julio A., *Professor of Botany in the University, and Director of the Botanic Garden, Coimbra.*
 May 1891. Henry, Augustine, M.D., *Professor of Forestry, Royal College of Science, Dublin.*
 Dec. 1905. Kjellman, Dr. Frans, *Professor of Botany in the University, and Director of the Botanic Garden, Upsala.*
 June 1902. MacMillan, Conway, *Minnesota.*
 Dec. 1905. Macoun, John, M.A., F.L.S., *Dominion Botanist on the Geological Survey, Ottawa.*
 June 1902. Maiden, J. H., J.F., F.R.S., *Director of the Botanic Garden, Sydney, N.S.W.*
 Dec. 1905. Mattiolo, Dr. Oreste, *Professor of Botany in the University, and Director of the Botanic Garden, Torino, Piedmont.*
 Dec. 1905. Miyabe, Dr. Kingo, *Professor of Botany, and Director of the Botanic Garden, Sapporo, Hokkaido, Japan.*

Date of Election

- June 1902. Miyoshi, Manabu, *Professor of Botany in the Imperial University, Tokio.*
- June 1902. Raunkjær, Christen, *Assistant in the Botanic Garden, Copenhagen.*
- Dec. 1905. Rodway, Leonard, C.M.G., *Government Botanist of Tasmania, Hobart.*
- Dec. 1905. Schröter, Dr. Carl, *Professor of Botany, and Director of the Botanical Museum, Zürich.*
- Nov. 1888. Scully, W. C., F.L.S., *Cape Town.*
- Feb. 1876. Sodiro, Luis, *Professor of Botany in the University, Quito, Ecuador.*
- May 1876. Terracciano, Dr. Nicolao, *Director of the Royal Gardens, Caserta, Campania.*
- Nov. 1888. Tyson, W., *Cape Town.*
- Dec. 1905. Vlădescu, Dr. Milail, *Professor of Botany at the University, and Director of the Botanic Garden, Bukarest.*
- Dec. 1887. Wildpret, H., *Director of the Botanic Garden, Orotava.*
- June 1902. Wille, Dr. Johan Nordal Fischer, *Professor in the University, and Director of the Botanic Garden Christiania.*

THE SOCIETY EXCHANGES PUBLICATIONS WITH—
AMERICA.

CANADA.

- Disco,* } Den Danske Arktiske Station.
Greenland, }
Halifax, . . . Department of Agriculture.
 Nova Scotian Institute of Natural Science.
Montreal, . . . Horticultural Society.
 Natural History Society.
Ottawa, . . . Geological and Natural History Survey of Canada
 Department of Agriculture.
Toronto, . . . Field Naturalists' Club.
 Canadian Institute.

COSTA RICA.

- San José,* . . Instituto Nacional.

MEXICO.

- Ecuinilla,* }
Chiapas, } Director, La Zacualpa Botanical Station.

UNITED STATES.

- Ames, Iowa,* . Department of Agriculture.
Ann Arbor, }
 Michigan, } University of Michigan.
Auburn, Ala., . Department of Agriculture
Austin, Texas, . Agricultural Experiment Station
Berkeley, Calif., University of California.
Boston, Mass., . Massachusetts Horticultural Society.
 Society of Natural History.
Cambridge, }
 Mass., } Harvard University.
Cincinnati, }
 Ohio, } Society of Natural History.
 Lloyd Botanical Library.
Colorado }
 Springs, Col. } Colorado College.
Columbia, Mo., . Library of University of Missouri.
Davenport, }
 Iowa, } Academy of Natural Sciences.
Indianapolis, . Indiana Academy of Sciences.
Ithaca, N.Y., . Cornell University.
Madison, Wis., . Wisconsin Academy of Sciences.
Manhattan, }
 Kansas, } State Agricultural College.
Milwaukee, }
 Wis., } Public Museum of Milwaukee.
Minneapolis, }
 Minn., } Botanical Department, University of Minnesota.
New Haven, }
 Conn., } Academy of Arts and Sciences.
New York, . . Academy of Sciences.
 American Museum of Natural History.
 Columbia University.
 Torrey Botanical Club.

- Philadelphia*, . Academy of Natural Sciences.
University of Pennsylvania.
Rochester, N. Y., Rochester Academy of Sciences.
St. Louis, }
Missouri, } Botanic Garden.
San Francisco, }
Calif., } California Academy of Sciences.
Topeka, Kansas, Academy of Science.
Urbana, Ill., . University of Illinois.
Washington, . National Academy of Sciences.
United States Geological Survey.
Smithsonian Institution.
United States Department of Agriculture:—Division of
Agrostology; Division of Botany; Division of Entomology; Division of Forestry; Division of Microscopy; Division of Pomology; Division of Soils; Division of Vegetable Pathology; National Herbarium; Office of Experiment Stations.

SOUTH AMERICA.

- | | |
|------------------------|------------------------------------|
| <i>Bogota, Rep. of</i> | } Ministry of Public Works. |
| <i>Columbia,</i> | |
| <i>Caracas, . . .</i> | Junta central Aclimatacion. |
| <i>La Plata, . . .</i> | Museo de La Plata, Rep. Argentina. |
| <i>Monte Video, .</i> | Museo Nacional de Monte Video. |
| <i>Rio de Janeiro,</i> | Museo Nacional. |

WEST INDIES.

- Jamaica*, . . . Botanical Department.
Trinidad, . . . Royal Botanic Garden.

AFRICA.

- Cape Colony, Botanical Department.*
Durban, Natal, Botanic Garden.

ASIA.

- | | |
|--------------------------------|---|
| <i>Calcutta</i> , . . . | Indian Museum.
Royal Botanic Garden. |
| <i>Ceylon</i> , . . . | Royal Botanic Garden, Peradeniya. |
| <i>Manga</i> , . . . | Bureau of Science. |
| <i>Straits Settlements</i> , } | Botanic Gardens and Forest Department. |
| <i>Buitenzorg</i>, . . |  | Botanic Garden. |
| <i>Tokio</i> , . . . | Imperial University College of Agriculture. |

AUSTRALASIA.

NEW SOUTH WALES.

- Sydney*, . . . Department of Agriculture.
Royal Society of New South Wales.

NEW ZEALAND

- Wellington*, . . . New Zealand Institute.

QUEENSLAND.

- Brisbane*, . . . Department of Agriculture.
 . . . Royal Society of Queensland.

1

WEST AUSTRALIA.

- Perth*, Department of Agriculture.

TASMANIA.

- Hobart*, . . . Royal Society of Tasmania.

VICTORIA.

- Melbourne*, . . . Department of Agriculture.
 . . . National Herbarium.
 . . . Royal Society of Victoria.

EUROPE

BELGIUM.

- Antwerp*, . . . Vlaamsch nat. en Geneeskundig Congress.
Brussels, . . . Académie Royale des Sciences, des Lettres, et des
 . . . Beaux-Arts de Belgique.
 . . . Institut Botanique, Bruxelles.
 . . . Société Royale de Botanique de Belgique.
Liège, Botanic Garden.

DENMARK.

- Copenhagen*, . . . Botaniske Forening.

FRANCE.

- Amiens*, . . . Société Linnéenne du Nord de la France.
Cherbourg, . . . Société Nationale des Sciences Naturelles et Mathé-
 . . . matiques.
Lyons, Société Botanique.
Marseille, . . . Faculté des Sciences de Marseille.
Paris, Société Botanique des France.
Toulouse, . . . Société Française de Botanique.

GREAT BRITAIN AND IRELAND.

- Aberwick*, . . . Berwickshire Naturalists' Club.
Belfast, Natural History and Philosophical Society.
Bristol, Bristol Naturalists' Society.
Buckhurst Hill, . . . Essex Field Club.
Cambridge, . . . Philosophical Society.

- Cardiff*, . . . Naturalists' Society.
Dublin, . . . Royal Dublin Society.
Edinburgh, . . . Royal Scottish Arboricultural Society.
 Royal College of Physicians.
 Edinburgh Geological Society.
 Royal Society of Edinburgh.
 Royal Physical Society.
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